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VOLUME LXVII JULY, 1957 NUMBER 7

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VOL. LXVII JULY, 1957 No. 7

A STUDY OF 500 STAPES MOBILIZATIONS.*†

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A. INTRODUCTION.

In previous papers,[1,2,3,4] we have presented our views on stapes mobilization, in which we emphasized variations in surgical technique and otosurgical audiometry including the nomograph guide. In the paper published in April, 1956,[4] the results in 189 cases were analyzed.

The present report will describe recent advances in this surgery, stressing the monitored step-by-step stapedolysis approach, the peri-basal and trans-basal maneuvers. It will analyze the primary results in 500 cases and show statistical trends in the long-range observations of some of these patients.

We have previously described the basic surgical physiologic principles in stapes mobilization surgery and have contrasted it with fenestration surgery.

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*Read at the meeting of the Western Section, American Laryngological, Rhinological and Otological Society, Inc., San Francisco, Calif., Jan. 19, 1957.

†Supported in part by grants from the National Institute of Neurological Diseases and Blindness, U. S. Public Health Service and the Central Bureau of Research of the American Otological Society.

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The authors gratefully acknowledge the technical assistance and collaboration of Seymour J. Brockman, M.D., and Irwin Harris, M.D.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication June 16, 1957.

We have presented our approach to the problem of selection of candidates in detail. In this respect we have some new data but still prefer to repeat our previous selection criteria—"One might consider as a candidate any patient with otosclerosis who has no specific anatomic or pathologic contraindications, and who has a bone conduction of not lower than 45 db., with a significant bone-air gap in the speech frequencies."

B. SURGICAL TECHNIQUE.

Our surgical technique is still based upon the premise that stapedolysis cannot follow one standard surgical maneuver. The very nature of the pathologic lesion makes it necessary to approach mobilization in a step-by-step pattern preferably monitored by audiometry.

It is indeed gratifying that Rosen, to whom belongs the credit of pioneer efforts in this surgery, has also recently pointed to this need for step-by-step surgical approach. He described a primary footplate approach and later a footplate fenestration approach in recent publications.[6,7,8]

In the April, 1956, paper, referred to above,[4] one of us (V.G.) stated "future improvements in stapedolysis techniques may well be based upon a *primary* application of force to the footplate region. At present, however, it remains the final region for lysis attempts in stapedolysis surgery."

Our current surgical technique consists of the following step-by-step pattern. (The preliminary approach to adequate exposure of the incudo-stapedial and stapedio-vestibular joints has been described previously).

1. Palpation of Incudo-malleolar Joint.

With the fine angulated needle probe engaged within the lenticular periosteum, the incus is gently tested for mobility. Even in the presence of a rigidly ankylosed stapes, there is a degree of mobility of the incus which is easily determined by such palpation. If the incudo-malleolar joint is fixed, as it may be in congenital anomalies or in adhesive otitis media, this diagnosis is all-important. Such incudo-malleolar fixa-

tion by itself, may well account for the entire conductive loss, or on the other hand, it may co-exist with stapedio-vestibular fixation and cause failure, if its presence is not realized. (If incudo-malleolar joint fixation is recognized, a stapes mobilization approach alone is usually inadequate.)

2. Palpation of Incudo-stapedial Joint.

The integrity of the incudo-stapedial joint is then assessed by palpation. This information is necessary before the locus of force application is chosen. A loose easily dislocated joint would call for the substitution of the capitulum for the lenticular process as the locus of choice.

3. Palpation for Degree of Footplate Ankylosis.

The next very important step is to test the degree of footplate ankylosis via the incus, if possible, or the capitulum.

It has been our experience that *safe trans-incudal* or *trans-capitular* force can be used successfully in relatively "early" or "mild" ankylosis states. By no means can these types be predicted always from the threshold, age, or duration of disease; however, in many of the "less mature" forms of the disease, the ankylosis may be confined to the anterior limb of the footplate, or occasionally to the posterior limb alone. In such instances, safe lysis may be possible by force applied to the entire ossicular chain via the lenticular process or the capitulum. The former is preferable since it has a slightly lesser tendency to dislocate the joint; however, if the joint is loose, to begin with, it is preferable to use force on the capitulum.

4. Technique of Trans-incudal or Trans-capitular Force.

Under the circumstances described above, when such palpation reveals a tendency to lysis of the footplate ankylosis, it is advisable to start the lysis approach in this manner. Obviously, if palpation revealed elastic or fragile crura, this approach should be discarded. (Crural fractures should be avoided! Even though such fractures may heal, our studies show that crural fractures seriously affect long range postoperative results, even though a concomitant footplate approach may yield temporary excellent lysis).

In the approach through the lenticular process or the capitulum, it is now our practice to use only needle probe digital force. (The use of an electrical hammer or micro-vibrator is now restricted to the footplate region).

Digital force is gentle but firm. During its application the entire ossicular chain must be observed as a *total mechanism* with special attention to the footplate region. The direction of force is alternately antero-posterior, postero-anterior, rotary, inferio-superior and superio-inferior. In most successful cases there will be a general loosening, and the stapes will usually be displaced slightly in a posterior direction. When effective displacement appears to have occurred an audiometric test with nomograph guidance is obtained. Such alternations of force application and audiometric tests are used until a decision is reached.

5. Footplate Techniques.

If palpation reveals a rigidly fixed footplate or if elastic or fragile crura prevent trans-incudal or trans-capitular force, attention is directed to the footplate.

It should be clearly understood that the footplate approaches call for excellent surgical exposure and *unquestioned visualization.* In most instances magnifications greater than 2.5X are required. This may call for the use of the dissecting microscope or powerful loupe-light combinations.

Careful inspection of the footplate region will reveal a multitude of pathologic possibilities. (We are just beginning to appreciate the variations in the gross pathology of "otosclerosis"). Such pathologic variations call for adaptations of surgical techniques to suit the special situations.

Such inspection of the footplate region requires an unimpeded view, particularly anteriorly. Since the majority of lesions predominate anterior to the anterior crus in the focus of predilection, it has been our observation that the niche of the oval window will frequently be filled in by pathologic bone in its anterior extremity. Concomitantly, the muco-periosteum in this region will be somewhat thicker and will obscure the extent and nature of the anterior lesion.

Visualization of this area calls for preliminary stripping of the muco-periosteum from the region along the lower border of the footplate and along the anterior promontory region immediately anterior to the anterior crus. This periosteal stripping can be readily accomplished by the use of a small needle probe or a very fine curet in which the muco-periosteum is dissected in an anterior and inferior direction away from the stapes to expose the underlying bone, and frequently the underlying otosclerotic lesion itself. Periosteal stripping will frequently produce a small amount of bleeding which is easily controlled by a small pledget of adrenalin in local contact for a few minutes.

It is quite illuminating to realize the increased visibility of the lesion and the degree of involvement of the anterior crus and the anterior aspect of the footplate after such periosteal stripping. Such visualization will enable more precise application of force to the peribasal region if bipod lysis is possible, and in rare instances to the footplate itself accompanied by an anterior crurotomy if such appears to be advisable.

Basically all footplate techniques must obey one primary physiological law, which we should like to stress—"The surgical objective of stapedolysis is adequate mobilization of the *entire middle ear mechanism* to transmit again the undistorted auditory vibrations to the perilymph, with essentially normal amplitude." Consequently, all footplate techniques must maintain some anatomic continuity between the ossicular chain and the mobile footplate or footplate fragment.

Fenestration of the footplate in which the vestibular perilymph pool is alone the recipient of airborne sound, is only a spurious victory surgically, since careful surgical audiometry in such cases will reveal a drop at step 4 of the nomograph (when the middle ear is closed). In our experience all such cases end as failures. Where such footplate fenestrations have been classified as surgical successes it must of necessity follow that these fenestrations were accompanied by inadvertent mobilization of the footplate, fragments of which were maintained in anatomic continuity with the ossicular chain.

Accordingly it is our practice to begin a footplate approach with a careful survey of the footplate and contiguous areas. If such a study reveals, for example, an advanced invasion of the anterior crus and anterior limb of the footplate by the otosclerotic process, attempts at "bipodal" (two legged) lysis are almost certainly doomed to failure. In such a case, the only possible hope of success is in "monopodal" (one-legged) lysis with anterior crurotomy as advocated by Fowler, Jr.[5] and lysis of the posterior footplate fragment in continuity with posterior crus. If, on the other hand, inspection reveals normal integrity of both crura but invasion of the footplate and ligament by otosclerotic bone, *peri-basal* use of a needle probe as advocated by Rosen[7] can be highly successful and result in preservation of the anatomic continuity of both crura with a mobile footplate—a normal, and thus desirable, physiologic state.

To achieve careful footplate lysis with attention to the above physiologic principles, force can be applied digitally with needle probes of varying sizes and angles, and tiny chisels; such instruments may also be used in severe ankylosis problems, in conjunction with the electric hammer, or microvibrator.

In using the peri-basal technique to attempt a bipodal lysis, it is desirable to insert the needle probe first immediately anterior to the anterior crus towards the vestibule through the region normally occupied by the annular ligament (which is frequently replaced by pathologic bone). If the disease is limited to the anterior limb, this maneuver alone may be adequate to produce lysis.

If adequate lysis is not demonstrated visually and *confirmed nomographically* the same procedure is carried out in the similar position posterior to the posterior crus, again through the region of the annular ligament.

In occasional cases it is necessary to repeat this approach inferiorly or superiorly.

In cases where the ankylosis is diffuse and severe with actual destruction of the footplate integrity, such attempts

are usually futile, and lysis is impossible. In cases where lysis has apparently been accomplished visually but not confirmed nomographically the prognosis is poor. It is true that such an occasional case may show dramatic post-operative improvement, but this is exceptional. (Such cases are food for speculation as to cause—one may predicate round window lesions, intra-vestibular otosclerotic extensions with perilymph blockade, etc.).

Preliminary observations point to a definite improvement in results since the above technical plan has been adopted.

In patients where severe ankylosis requires major force applications using chisel or hammer force, the prognosis is not so good as in cases where needle probe force is adequate for lysis.

In general, bipodal lysis seems more successful than monopodal lysis. This is to be expected because of the more advanced degree of disease in the latter group; nevertheless, enough satisfactory cases have been "salvaged" to make the utilization of such "extreme" methods justifiable.

In cases where nomographic study reveals a drop at step 4 in spite of adequate visual demonstration of lysis and an excellent rise at step 3, we assume the existence of a footplate fenestra, which may co-exist with a mobile bipodal or monopodal footplate. If we suspect such a footplate fenestra, a tiny piece of gelfoam moistened with saline is placed in the intercrural space. Such a "gelfoam barricade" will seal the fenestra partially and reverse the nomograph, producing a rise at step 4 if the stapes is mobile but increase the drop if the footplate has been fenestrated without mobilization. Such a "gelfoam barricade" may actually encourage quick fibrinization and closure of a fenestra.

If the gelfoam barricade produces a sharp drop on repeated step 3 tests, it is likely that a footplate fenestra alone is present without a co-existent mobile footplate fragment. This would then suggest further attempts at *peri-basal* probing to achieve a mobile footplate or footplate fragment in monopod or bipod continuity with ossicular chain and drum.

C. SURGICAL PROBLEMS.

1. Incudo-stapedial Dislocation.

We still feel that it is extremely important to prevent incudo-stapedial dislocation wherever possible and to attempt repositioning of the joint components if such dislocation is unavoidable.

2. Crural Injuries.

Crural injuries have become extremely infrequent since we have adopted greater utilization of footplate techniques. As soon as preliminary palpation reveals that it is desirable to transfer the force application to the footplate, further manipulations involving the crura are stopped. This change in surgical attack has greatly diminished the number and extent of crural injuries.

3. Hemorrhage.

Our recent perfection of a micro-suction coagulator has greatly diminished the problem of bleeding in this surgery. It is important to keep bleeding to a minimum, since it not only confuses the progression of the surgical procedure by blocking the round window niche, or adding inertia to the ossicular chain, but it also militates against early healing of the middle ear.

4. Operative Vertigo.

Our observations show a great increase in vertigo since we have been employing footplate techniques more extensively. Not only do we have more primary operative vertigo, but there is a good deal of continued vertigo post-operatively, in some instances as long as post fenestration vertigo; however, the vertigo is quite different in several characteristics. It is frequently unaccompanied by nystagmus and appears to be primarily *utricular* in nature. It is precipitated by positional changes unlike post fenestration semi-circular canal vertigo. In most instances, however, it is not a serious post-operative problem, and in all instances it finally disappears. It does call for more extensive use of anti-vertigo drugs and necessitates a slightly longer period of post-opera-

tive disability; nevertheless, the improved results with the footplate technique warrant its continuation despite the increase in vertiginous morbidity.

Intramuscular dramamine or thorazine may be indicated during surgery or in the post-operative period. Oral dramamine is continued for five to ten days in many cases.

5. Antibiotics.

All patients are covered pre- and post-operatively by broad spectrum antibiotics. At the present time we are using Mysteclin (which is a combination of Tetracycline and Mycostatin) in dosages of 250 mgms. t.i.d. for one day before surgery and five days following surgery. We have given up the use of penicillin or its derivatives because of the increasing frequency of penicillin sensitivity.

6. Complications.

It is pleasant to report that complications of stapedolysis surgery are still minor and rare as a rule. We are not unaware of reports of facial paralysis and dead labyrinths that have appeared in recent months; fortunately, we have had no such occurrences in our series.

We have had no major instances of persistent labyrinthitis and only one case of facial paresis coming on six days post-operatively which lasted one week. A few cases of transitory serous labyrinthitis subsided without significant evidence of cochlear damage.

The primary post-operative complication at the present time is *vertigo* as a result of footplate techniques which have been described above. This is probably due to the contiguity of the utricle to the footplate.

D. ANALYSIS OF RESULTS IN 500 CASES.

The data in this report supplements a previous report on 189[4] cases and covers consecutive cases on which surgery was performed between November, 1954, and November, 1956. Unless otherwise stated the results reported are derived from the primary post-operative tests approximately two weeks

after surgery. The terminology here employed is the same as that used in the previous report and is briefly defined as follows:

a. "Thresholds"—The values of acoustic thresholds are stated in terms of the equivalent S.R.T. derived from the Fletcher formula.* Thus since audiometric measurements vary in 5 db. steps, the equivalent S.R.T. values used here usually vary in 2½ db. steps.

b. "No Change"—The term "no change" is used to indicate a post-operative air conduction level that has not changed by more than plus or minus 5 db., with respect to pre-operative air conduction.

c. "Losses"—Losses are considered to be such when the post-operative air conduction level is 7½ db. or more below pre-operative air conduction.

d. "Partial Gains"—Partial gains are gains which are 7½ db. or more above pre-operative air conduction, but less than those defined as success.

e. "Success"—Dual criteria must still be retained for success, since most others who report in this field are still using the fenestration criteria which consider any post-operative levels within 30 db. of normal as successful; however, we are convinced that removal of the air conduction block (or eradication of the bone-air gap) should also be considered as a success regardless of the final air conduction level. Since audiometric measurements are not considered accurate to better than 5 db., we are using, as before, an arbitrary value of 7½ db. below pre-operative bone conduction, above which cases are considered successful. (In general the only confusion likely to occur from this dual definition of success, lies in the region where air conduction is between 30 and 40 db. and bone conduction is near normal. Most of the successful cases by the 30 db. standard only, lie in this area and materially improve the results reported for such groups. Approximately 43 per cent of the successes reported qualify in both

*An average of the two best threshold responses at 500, 1,000 and 2,000 cycles.

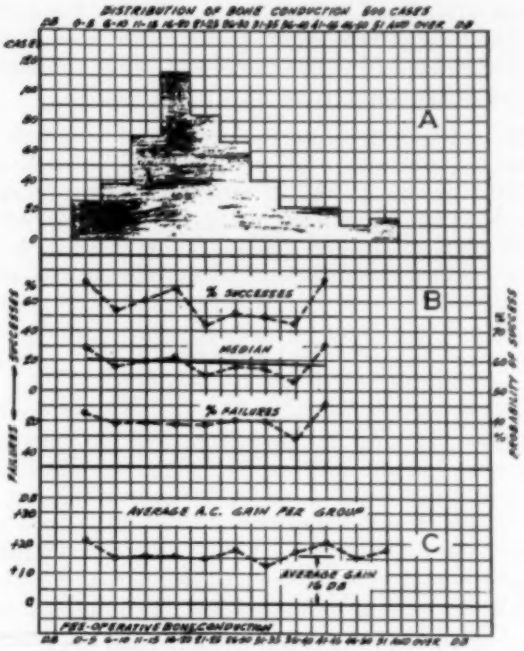

Fig. 1. Bone conduction characteristics of 500 cases. "A" shows the case distribution of pre-operative bone conduction in 5 db. groups. "B" and "C" indicate no variation with different bone conduction thresholds that would be useful in candidate selection.

categories. The remainder are about equally divided between those cases which qualify in one category only.)

These 500 cases are consecutive, and the candidates have, in general, been selected only to the extent that sufficient air-bone gap existed to warrant an attempt to remove the conductive defect surgically.

A number of approaches, which have been considered potentially significant in candidate selection, are used in analyzing results of these cases.

1. Pre-operative Bone Conduction.

In Fig. 1 "A" the distribution of candidates with respect

to pre-operative bone conduction is shown in the histograph form. The level of bone conduction in 5 db. groups is shown on the horizontal axis above the graph, while the number of cases is shown on the vertical axis to the left.

In "B" of Fig. 1 immediately below the histograph of "A" is shown the percentage of successes and failures in each of the 5 db. groups of "A" as a means of attempting to determine whether some bone conduction groups are more favorable than others for surgical intervention. A median has been indicated which is midway between the per cent success plotted above a zero reference and per cent failures plotted below this same reference. Gains which are not successes are ignored. The absolute values of this median may be questioned, but it should clearly show any overall trend toward success or failure in the various groups. A straight line, obtained by the "least squares" method, has been drawn through the median points to identify more readily any trend which may be present. This line shows only an insignificant change due to various degrees of pre-operative bone conduction. (It may be worth noting, however, that the sharp rise of the median point at the 41-45 db. bone conduction group is apparently characteristic and not random, since it has appeared in the data from the beginning.)

In section "C" of Fig. 1, is shown the average air conduction gains in each of the same bone conduction groups. The average gain for all groups is 16 db., and it will be apparent that except for minor excursions, the characteristic is essentally flat over the whole range of bone conduction groups represented. Thus, with the exception of the 0-5 db. group and the 41-45 db. group on the other extreme, there does not appear to be any particular advantage shown by evaluation of candidate bone conduction, with respect to either success, failure or air conduction gain.

2. Pre-operative Air Conduction.

Air conduction gains and losses are shown in Fig. 2 using the pre-operative air conduction as a reference zero with gains plotted in 10 db. groups to the left of the reference line, and losses plotted in similar groups to the right of the

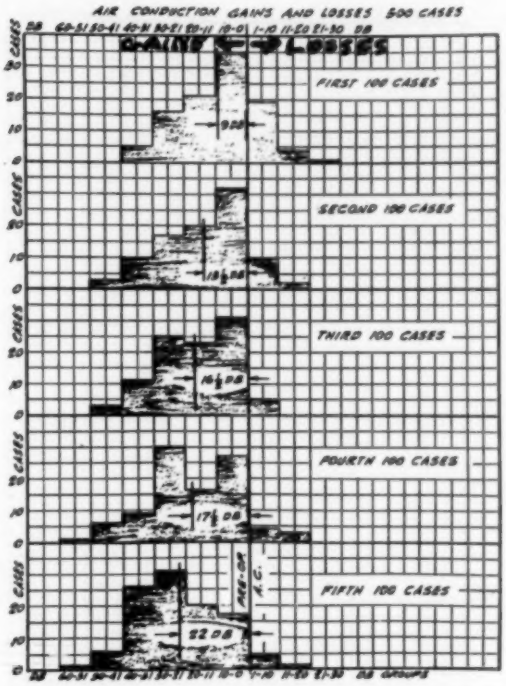

Fig. 2. Air conduction gains and losses in 500 cases. Note the steady increase in average gain with each 100 cases.

reference line. Since surgical technique has consistently improved with experience, it is felt that the air conduction gains and losses are best shown in groups of essentially 100 each. In the first 100 the average air conduction gain was 9 db., the second 100 cases increased this gain to a 13½ db. average, and each successive group will be seen to show a similar improvement in average air conduction. The last hundred cases show a 22 db. air conduction gain with "losses" and "no change" reduced to 12½ per cent. (In some ways the evaluation of air conduction gains and losses as graphed in Fig. 2 may be a better criterion of results than the surgical deficit, because it is not only more readily visualized as a

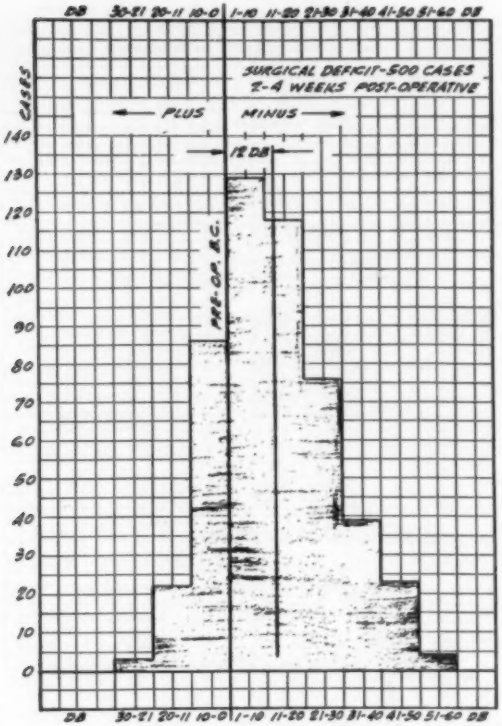

Fig. 3. Surgical deficit. The relation of post-operative air conduction to pre-operative bone conduction—the mean value of 12 db. compares to 15 db. in fenestration.

positive improvement over pre-operative conditions, but in addition it does not put a premium on selection of cases in which the air-bone gap is small.)

3. The "Surgical Deficit".

The surgical deficit of the whole 500 cases is shown in Fig. 3 where the zero reference line is pre-operative bone conduction, with post-operative air conduction better than bone conduction shown to the left of the line, and failures to achieve pre-operative bone conduction shown to the right

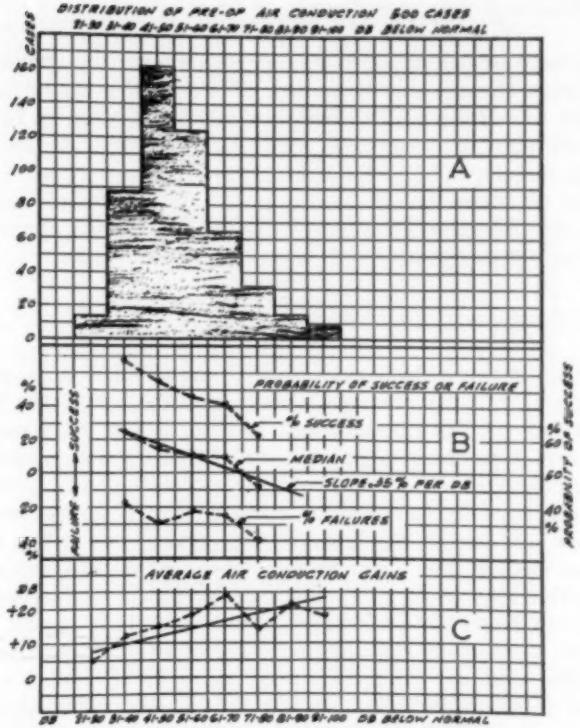

Fig. 4. "A"—Distribution of pre-operative air conduction. "B"—The probability of success is less as the air conduction loss grows greater.

of the line. As before, the db. groupings are shown at top and bottom and the number of cases on the vertical axis to the left. The average surgical deficit for 500 cases as shown, is 12 db., which is the average db. value by which stapedolysis failed to achieve what might be considered optimum success. When broken down into 100 case groups, the surgical deficit of the first hundred cases was 17 db., which improved to 10 db. in later groups. The average shown is, of course, somewhat degraded by the early results; but with existing techniques the average surgical deficit has apparently settled at a value of somewhere between 10 and 11 db.

4. Candidate Selection Trends.

So far we have not been able to predict with any appreciable accuracy the success or failure of any given candidate for stapes mobilization; however, our 500 cases begin to furnish enough data to show some fairly firm trends. We have already examined bone conduction distribution in Fig. 1 and found no trend that is truly significant, in spite of the fact that pre-operative bone conduction has been used almost exclusively as a criterion for fenestration candidates.

a. Pre-operative Air Conduction.

The distribution of pre-operative air conduction is shown in Fig. 4 "A". Unlike bone conduction distribution, the probability of success characteristic plotted in "B" as a median between percentage of success and failure shows a marked change with air conduction variation. The slope of a straight line representing this median characteristic is approximately .35 per cent per db. as shown on the vertical axis to the right of the median line. The slope of this median characteristic is sufficiently great, so that it may be useful in forecasting for a candidate his probability of success. It is logical that the air conduction characteristic should show a positive indication, since air conduction response is, in general, a measure of footplate fixation. In "C" the average air conduction gains are plotted against the same db. grouping, and while the probability of success in "B" decreases with increased pre-operative air conduction loss, the average post-operative gain in each group increases under the same condition. It should be noted that in each group the air conduction loss is progressing at the rate of 10 db. per group, whereas the average gain is only increasing at about 2 db. per group. Thus, in the 31-40 db. group the average gain is 10 db. while in the 70-80 db. group the average gain of 19 db. is greater, but not nearly so effective in eliminating the conductive loss. It should be noted that the average gain characteristic shown in "C" is an average only, which of course, is derived from all cases, good or bad, and is not something that can be applied directly to any individual case.

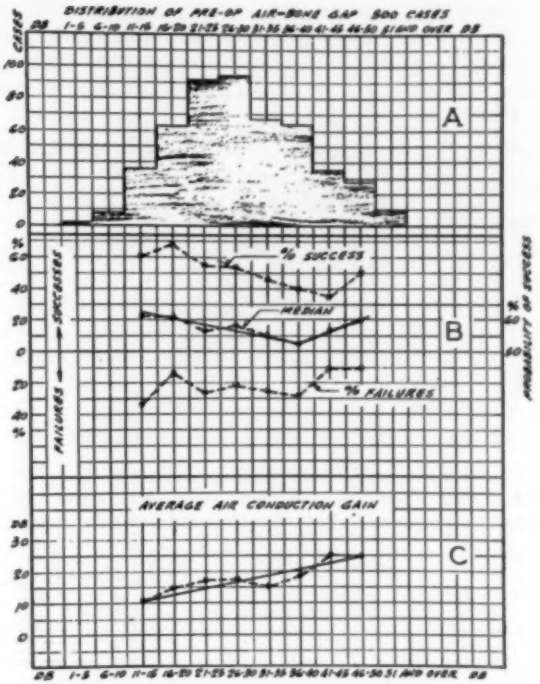

Fig. 5. Distribution of preoperative air-bone gap—500 cases. Although the realized gain increases with the air-bone gap, the probability of success is not significantly different in the various groups.

b. Air-bone Gap.

Fig. 5 "A" shows the distribution of gap between preoperative air conduction and bone conduction. The gap is considered here as another possible lead for candidate selection and in "B" the probabilities of success, as shown by the median line indicates a gradual drop to the 36-40 db. group and then a rise to the 46-50 group. This characteristic would be questioned except that as in the bone conduction graph the characteristic shown has consistently been typical as the data has been progressively collected; additional data tending to establish this characteristic rather than to smooth it

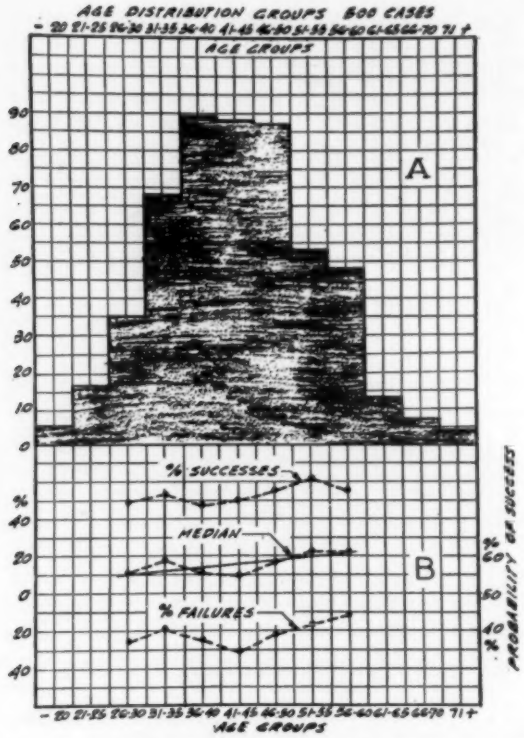

Fig. 6. Age groups of 500 cases. The probability of success improves slightly with age up to 60 years.

out. One possible explanation may be that the otosclerotic lesion tends to mature and become brittle under certain conditions and can thus be broken with a good chance of its remaining mobile. Unfortunately, we do not have sufficient data at greater air-bone gaps to indicate whether the probabilities of success continue to increase in the same manner. In Fig. 5 "C" the average air conduction gain is shown to rise with increased air-bone gap at approximately the same rate as that noted in Fig. 4. As previously stated, however, the rate of rise is so much less than the rate of increasing defect that it falls far short of compensating for the defect.

This increased air conduction gain with increased gap should probably be expected, since the maximum gain which can be obtained by mobilization is determined by the air-bone gap. Thus the greater the gap, the greater the potential gain.

c. Age of Candidate.

Candidate age has been considered to have some possible effect on selection of candidates. Fig. 6, which shows the distribution of age with respect to our 500 cases, seems to indicate that, while there is a slight variation in probability of success with respect to candidate age, at least up to the age of 60 years, the probability of success increases with age. While there are some candidates considerably older than 60 years who have been patients for this operation, there are not enough in older groupings to justify drawing conclusions therefrom. The difference shown by the median characteristic is not large enough to be particularly significant, except that it shows that the candidate should not be discharged because of age. This characteristic may again be another indication that the mature otosclerotic lesion is optimum from a surgical standpoint.

d. Sex of Candidate.

With respect to the effect of sex on stapes mobilization candidates, it was found that both male and female groups were within 2 per cent of the overall averages with respect to success or failure. Of the 500 patients 333 were females and 167 (or one-third) were males.

5. Overall Successes.

In 500 cases the overall average of success by our dual standard is 52 per cent total with some 43 per cent which qualify in both categories. Approximately 24 per cent of the total cases eventually become failures for various reasons. The remaining 24 per cent of the total cases are gains which vary from 7½ db. up to as much as 40 db., but which do not qualify as successes in either of the stated categories.

The percentage of successes has gradually and consistently

increased with added experience and improved techniques as shown by the following table:

First	100 cases	=39% Successes.
Second	100 cases	=50% Successes.
Third	100 cases	=53% Successes.
Fourth	100 cases	=57% Successes.
Fifth	100 cases	=62% Successes.

Where, as above, cases must be arbitrarily grouped as "successes," "failures," etc., there are always marginal cases that may shift back and forth between groups with the passage of time, and thus introduce slight discrepancies in results obtained from data collected at different times for different purposes.

6. Primary Post-operative Failures.

Primary post-operative failures (at first post-operative audiogram) may be temporary or permanent.

1. Temporary
   - *a.* Tympanic blood clot.
   - *b.* Otitis media.
   - *c.* Drum perforation.
2. Permanent.
   - *a.* Operative failures.
     - (i) Non-mobilization.
     - (ii) Footplate fenestra (pseudo mobilization).
     - (iii) Ossicular chain disruption.
   - *b.* Post-operative adhesive otitis.
   - *c.* Re-ankylosis by otosclerosis.

Post-operative adhesive otitis and re-ankylosis by otosclerosis are causes of failures which may come on at any time, either early or late in the post-operative period.

In Fig. 7 "A" "Operative failures" are cases which apparently have failed to respond at surgery. There were 82 such cases (16½ per cent of 500; 75 per cent of this number remained in this classification, 56 per cent "No change" and 19 per cent "Losses". Of these 82 cases, however, 25 per

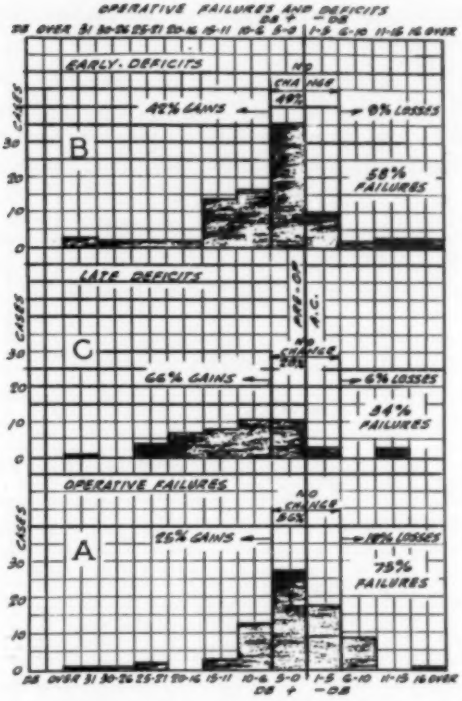

Fig. 7. Final results in cases apparently failures or closures. "A"—Cases apparently failures at surgery prove to be 75% "no change" or "losses." "B"—Apparently early closures resulted in gains of over 5 db. in 42% of such cases. "C"—Cases which showed serious losses over one month after surgery show final gains of over 5 db. except in 34% of these cases.

cent later made air conduction gains of 7½ db. or more with respect to the pre-operative condition. Only two of these gains brought the cases up to the "Success" rating.

"Early deficits" are cases which responded satisfactorily at surgery, but showed losses at post-operative tests. Initially it is seldom possible to separate transient or temporary deficits from permanent losses, thus Fig. 12 "B" includes both. There were 94 such cases or 19 per cent of the 500 total. Of these 94 cases 58 per cent were actual failures, while 42 per

cent eventually achieved gains of 7½ db. or more; some achieving a success rating.

Fig. 12 "C" shows the progress of cases called "Late deficits" initially classified as "re-ankylosis" and/or adhesive otitis. These are 48 cases which tested satisfactorily as successes through surgery and including the first post-operative

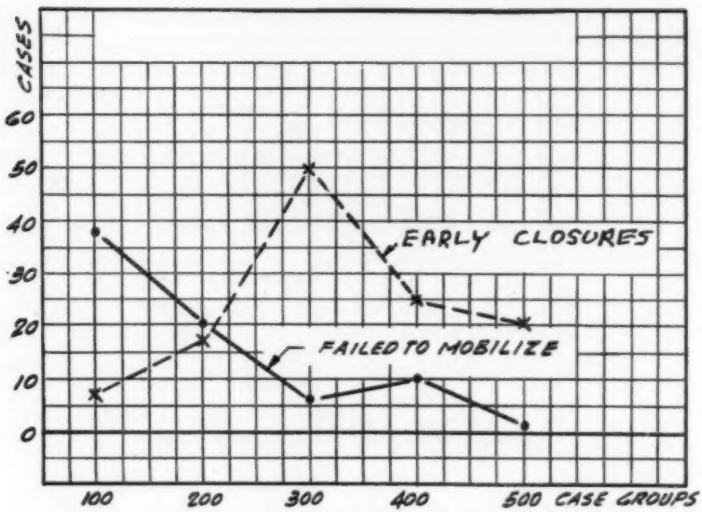

Fig. 8. Results of changing techniques. As the area of attack shifted from the incudo-stapedial junction to the footplate, the apparent failure to mobilize dropped sharply, but the early closures increased to nearly half in the third 100 cases due to footplate fenestration. The differential diagnostic technique employing a gelfoam barricade corrected this condition while failures to mobilize remain low.

tests, but which regressed subsequently by 10 db. or more. Approximately one-third of these cases prove to be failures, while two-third have not regressed to less than 7½ db. above pre-operative air conduction, thus indicating that in two-thirds of this classification there is only partial re-ankylosis or some other post-operative complication.

Non-mobilization or "failure to mobilize" was a major factor in earlier cases, but dropped sharply with changing

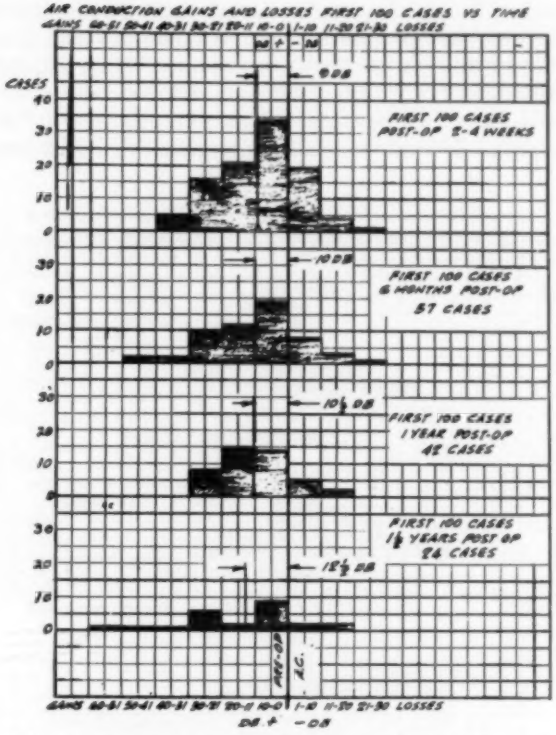

Fig. 9. The effect of elapsed time on the first 100 cases.

techniques. This is shown in Fig. 8, where the total number of 500 cases is divided into five groups of 100 each. In the first 100 cases there were some 38 which failed to mobilize. As the attack on the fixed stapes was broadened to include the footplate the number of cases failing to mobilize was reduced sharply, as shown at the 200 and later groups; however, as more approaches were made to the footplate, the number of failures due to apparent early closure increased sharply, and in the 300 group reached an alarming peak of 50 cases. This was very largely due to inadvertent footplate or "oval window fenestration." Analysis of the marked

increase in "early closures" revealed that such footplate fenestration yielded an impression of temporary surgical victory followed by early post-operative failure. When this problem was recognized and the technique revised, these so-called "early closures" dropped sharply in the 400 and 500 groups. In the final 500 group, failure to mobilize has practically

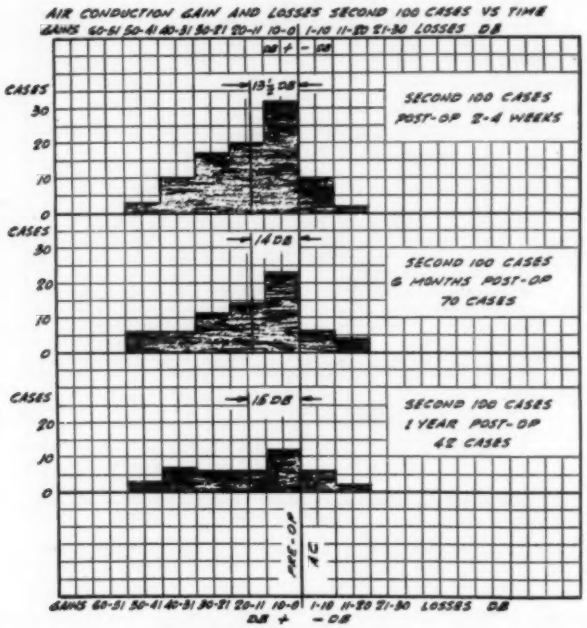

Fig. 10. The effect of elapsed time on the second 100 cases.

disappeared, there being one case of this kind in the last group of 100, while at the same time the "early closures" have dropped to 21, many of which are temporary.

7. Maintenance of Successful Results.

The probability of maintaining gains made in stapedolysis appears very good from the data available, and it is probable that the data which we have is less optimistic than the actual

facts, since in our observations many patients who have experienced successful operations see no reason for returning for post-operative tests at six months or later. On the other hand the unsuccessful cases are very apt to return at frequent intervals. Fig. 9 shows the air conduction gains and losses as a function of elapsed time for the first 100 cases. The

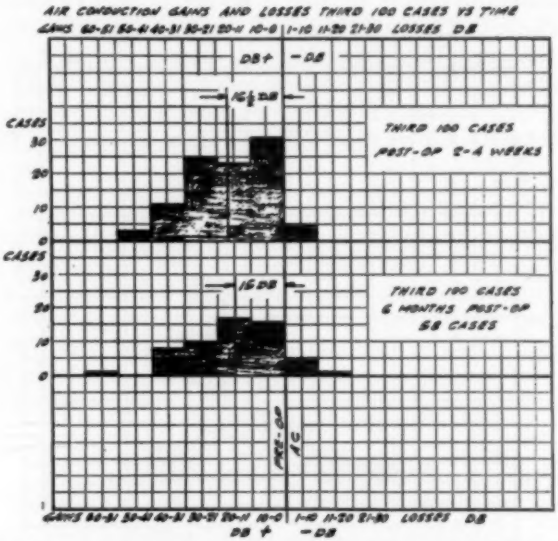

Fig. 11. The effect of elapsed time on the third 100 cases.

average gain as shown for the first post-operative period of 2 to 4 weeks is 9 db. At six months 57 cases were reported and the average gain had increased slightly to 10 db. At one year the number of patients reporting had reduced to 42, but the average had again increased slightly to 10½ db. At one and-a-half years, data on only 24 cases are available, which is hardly significant, but for what it is worth, the average air conduction gain had increased to 12½ db.

In Fig. 10 the progress of the second 100 cases is shown up to, and including one year, with again a slight increase

of average air conduction with the passage of time. Fig. 11 shows the third 100 case status at 2 to 4 weeks post-operative, and again at six months, where a slight reduction is shown from an average of 16½ db. to 15 db. Insufficient data is available on the fourth and fifth hundred cases to warrant drawing any conclusions with respect to time from these later patients.

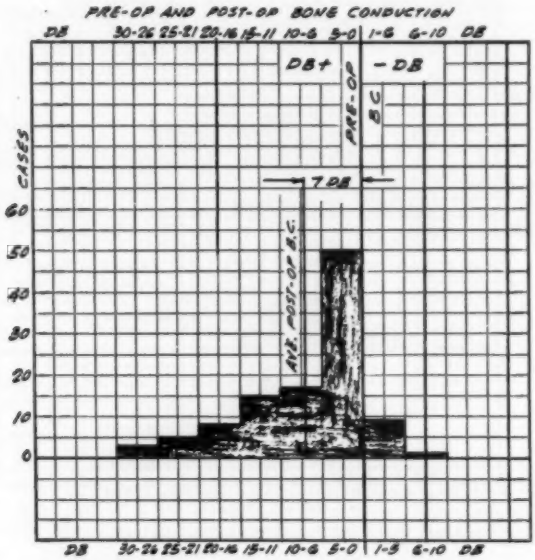

Fig. 12. The relation of preoperative bone conduction to postoperative bone conduction. An average improvement of 7 db. is shown in these cases.

8. Comparison of Pre- and Post-operative Bone Conduction.

Our collection of post-operative bone conduction data has been inadequate, so that we have available at *six months* only 108 post-operative bone conduction tests of the total 500; however, the information with respect to post-operative bone conduction vs. pre-operative bone conduction, is shown in Fig. 12. The distribution of gains and losses is shown plus and minus the pre-operative bone conduction reference, and while

the greatest number of cases show little change, the mean has improved by 7 db. over the pre-operative condition, and in some three cases this improvement is as much as 27½ db.

RE-ANKYLOSIS.

Re-ankylosis may be partial or complete, and occurs in a significant number of patients. As our period of observation increases, we see more and more evidence of both early and late re-ankylosis. It must be stressed that otosclerosis from our gross observations is certainly more than one disease. A number of conditions produce stapes ankylosis. The degree of bone involvement, both pathologically and anatomically, is highly variable.

The adequacy of lysis in these varying degrees of "otosclerosis" is also quite varied. Consequently, it is to be expected that re-ankylosis will occur and that it will continue to occur regardless of technique employed, since the basic underlying disease process is quite oblivious of the nature of surgical attack directed upon it. It is quite likely that time will reveal the necessity for revision in re-ankylosis in a large number of cases—the exact percentage being open to further study.

SUMMARY AND CONCLUSIONS.

1. Surgical technique in stapes mobilization is now based on a step-by-step monitored approach which includes increasing use of footplate maneuvers.

2. Footplate fenestration as a primary procedure is frequently followed by early closure and failure.

3. Peri-basal footplate lysis with either "monopod" or "bipod" continuity with the ossicular chain is physiologically sound.

4. Utricular vertigo is more common following footplate surgery.

5. Immediate as well as long range results have improved with newer techniques.

6. In candidate selection one marked trend, with respect to probable success, is apparent in pre-operative air conduction. Age and the pre-operative air-bone gap show small but possibly significant variations.

7. Successful results have been obtained in 52 per cent of the total group of 500 cases. Significant gains were obtained in an additional 24 per cent. The remaining 24 per cent were failures for various reasons.

8. Successful results in the last group of 100 cases have reached 62 per cent, significant gains 29 per cent and failures 9 per cent.

BIBLIOGRAPHY.

1. Goodhill, V.: Trans-Incudal Stapedolysis for Stapes Mobilization in Otosclerotic Deafness. The Laryngoscope, 65:693-710, Aug., 1955.

2. Goodhill, V.: Surgical Audiometry in Stapedolysis (Stapes Mobilization). *A.M.A. Arch. of Otolaryngol.*, 62:504-508, 1955.

3. Goodhill, V., and Holcomb, A. L.: The Surgical Audiometric Nomograph in Stapedolysis (Stapes Mobilization). *A.M.A. Arch. Otolaryngol.*, 63:399-410, 1956.

4. Goodhill, V.: Present Status of Stapedolysis (Report on 189 Cases). The Laryngoscope, 66:333-381, April, 1956.

5. Fowler, E. P., Jr., and Bassek, M.: Anatomical Factors in Stapes Mobilization Operation. *A.M.A. Arch. Otolaryngol.*, 63:589-597, 1956.

6. Rosen, S.: Mobilization of the Stapes to Restore Hearing in Otosclerosis. *N. Y. Jour. Med.*, 53:2650, 1953.

7. Rosen, S.: Mobilization at the Footplate of the Fixed Stapedial Footplate: Development of the Mobilization Technique for Restoration of Hearing in Otosclerosis. *Acta Oto-Laryngol.*, 45:533, 1955.

8. Rosen, S.: Fenestra Ovalis for Otosclerotic Deafness. *A.M.A. Arch. of Otolaryngol.*, 64:227-237, 1956.

THE FENESTRATION OPERATION USING MINIMAL IRRIGATION.*†

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As we have stated previously,[1] "It is difficult to explain our successes and failures when the function of the cochlear mechanism still belongs in the realm of theory." In spite of our lack of knowledge, the fenestration operation is an accepted procedure. The technique was first developed by the ingenuity of Holmgren and Sourdille, then later the one-stage Lempert endaural approach made consecutive successful results possible. Modifications by Shambaugh, Lempert and others still leave us with the basic pattern laid down by Lempert[2] in 1942. Despite adequate training, including cadaver and animal work, the otologic surgeon who overlooks minute details may have many unexplained failures. It is the purpose of this paper to stress a few important details and to report our results with adherence to this minutae.

As Lempert[3] has stated, "The otologist doing fenestration surgery cannot possibly acquire an appreciation of the complexity of the problems involved in this surgery, nor hope to improve himself nor the surgery itself, unless he insists on revising and carefully studying his failures."

It is just 19 years since the first fenestration was carried out at St. Michael's hospital here in Toronto, and successful cases have existed from the beginning. A recent audiogram

*Read at the meeting of the Eastern Section of the American Laryngological, Rhinological and Otological Society, Toronto, Canada, Feb. 1, 1957.

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Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 23, 1957.

was obtained on a case operated by one of us (J.A.S.) in 1941. A practical level of hearing resulted and was maintained in the operated, or right ear, for 16 years (see Fig. 1).

Adin and Shambaugh,[4] in a report of 10 years' results, Campbell[5] with seven years' results, state that lasting improvement occurs in Class A patients, and it is also apparent from our studies that the hearing improvement which is present

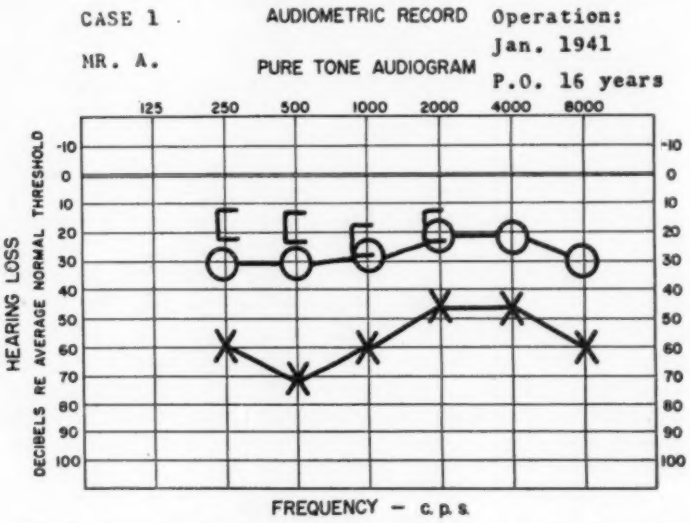


Fig. 1. Post-operative level in right ear of 25 db., sixteen years after fenestration.

one year after the operation, can be maintained approximately at that level.

Our early results showed occasional inconsistencies, either due to faulty selection or some error in procedure, when so-called ideal cases did not reach a satisfactory level, or the converse occurred. As far as selection is concerned, we group cases as A, B, or C, depending upon the degree of air conduction loss and the cochlear reserve as determined by bone conduction loss. We found our hearing aid style bone con-

ductor the best type, but many false levels occurred (see Fig. 2). Cawthorne[7] believes that bone conduction should not be charted on the same audiogram with air conduction, since it might be inferred that they are of comparable accuracy. As a result, a "precision" audiometer was developed at this center in an effort to combat this discrepancy.

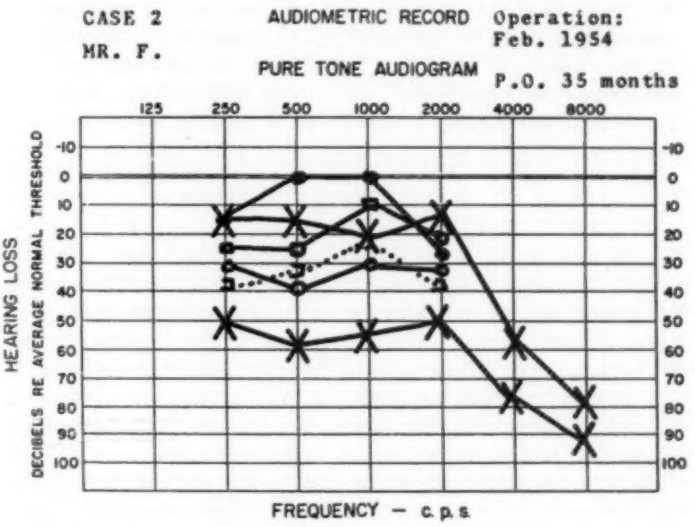


Fig. 2. Post-operative level, 17 db., left ear. Bone conduction average readings by four different otologists 8, 18, 28, 30 db.

Having classified the case to the best of our ability the next problem was to investigate our surgical technique. About six years ago a detailed description of the fenestra was made in all operative reports as to size, bleeding, accidents, etc. It was hoped that a subsequent review of these incidents might help us discover the important details necessary for a successful surgical result. Even though the majority of cases were successful, there were a few unexplained failures. The general practitioners and the public gradually grew to feel that all fenestrations were doomed to failure, sooner or

later, and little heed was paid to the majority of successful cases.

About this time the stapes mobilization procedure was reported,[9] and many otologists stopped "fenestrating" and started "mobilizing". This operation has proved successful in about 40 per cent of patients, but the percentage of success does not compare with fenestration surgery in ideal cases. We think that the surgeon who carries out the mobilization procedure should be prepared to go ahead with fenestration in the unsuccessful cases. Already many patients feel they have had "the operation" after the mobilization procedure has failed, and decide to settle for a hearing aid. The best hearing level after stapes mobilization approximates the bone conduction curve. Although this gap below the zero line is probably due to existing cochlear involvement, Wolff[10] has reported that diseased portions do exist in the joints of the middle ear bones in otosclerotic ears. This joint stiffness may be the cause of reduced transformer action of the middle ear bones despite the mobility of the stapes, effecting an increased load on the drum membrane. The question arose, "Why can't we obtain normal hearing after fenestration?" The reason has been set forth by Wever[11] that in cats, after removing the middle ear bones, but leaving the stapes footplate, the best level one could obtain was a loss of 28 db. This was explained as being due to the destruction of the impedance matching ossicular chain which transfers sound waves from air to fluid; however, on review of earlier cases, occasionally an unexplained 5 to 15 db. level was obtained after the fenestration, but this was not the rule. In other ear operations such as Fig. 3, a level of 10 to 15 db. was obtained in the right ear after a modified radical procedure and a level of 10 db. in the left ear after a radical mastoidectomy on the same patient. Fig. 4 illustrates a case of fusion of the malleus to the promontory.

The removal of the incus and malleus and placing the drum membrane in contact with the stapes capitulum resulted in an 8 db. level from an original 33 db. loss.

Fig. 5 reveals a 0 to 5 db. level obtained by application of a

thin skin graft to the stapes capitulum in a case of congenital atresia which had a 50 to 55 db. loss in that ear prior to surgery.

Wever and others have suggested the functioning round window as the principal path of sound waves entering the cochlea, but whatever the mechanism, we felt that possibly normal or near normal levels might also be obtained after

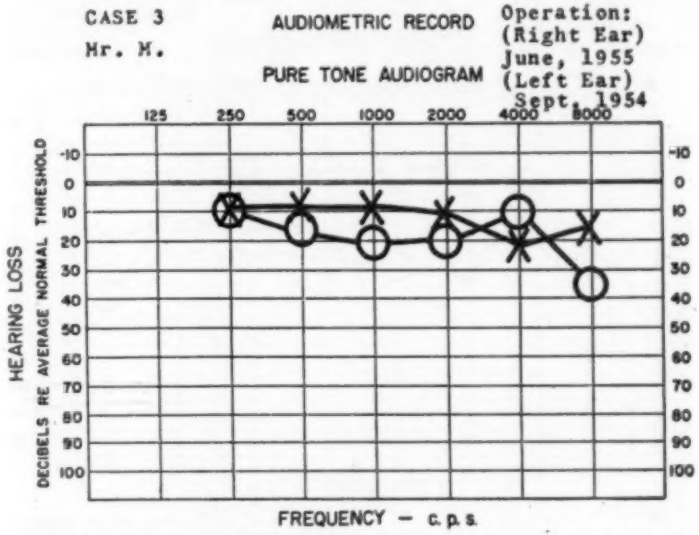


Fig. 3. Post-operative radical mastoidectomy without graft, left ear; modified radical mastoidectomy, right ear.

fenestration. Such a result would depend on the cochlear reserve and the prevention of further degeneration of the delicate end-organ as a result of surgical interference, the inference being that surgical intervention with the resultant serous labyrinthitis could depress the hearing from the time of operation to a greater or lesser degree beyond the existing cochlear reserve.

Since January, 1954, and with this in mind, a definite effort

has been made to keep the irrigation solution from entering the fenestra, but if necessary an eye dropper was used to wash bone chips or blood clot from the fenestra. Quite frequently a vessel might quickly start to bleed from the middle ear mucosa or mastoid bowl, and suction with continuous irrigation (Shambaugh[12]) had to be restarted. We adopted Lamp's solution[13] in 1953 to replace normal saline, which can

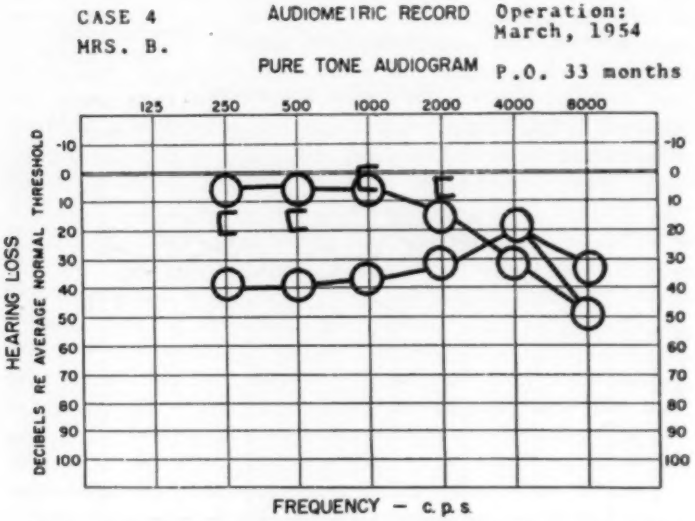


Fig. 4. Post-operative level of 8 db. in a case of fixation of the middle ear bones, particularly the incudo-stapedial joint, no fenestration, stapes mobile.

cause severe and irreversible cellular damage.[14] This fact was demonstrated by Pomerat and stimulated us to try to avoid further trauma to the mebranous duct by discontinuing all irrigation. Prior to this date, but adopting Lamp's solution and still using continuous irrigation, a decrease in post-operative vertigo was noticeable.

Shambaugh[15] is attempting to improve on Lamp's solution by using the Pomerat method, and varying the concentrations of salt solutions on the epithelium of tissue cultures of the

organ of Corti of the cat, in order to obtain a solution isotonic with the endolymph. With the cupola technique of Lempert[3] it was possible to avoid bone chips and dust from entering the fenestral rim in most cases and still maintain the dry technique. After removal of the lid, the flap should be placed in position over the fenestra as soon as possible to avoid any foreign material (blood) entering the window. In

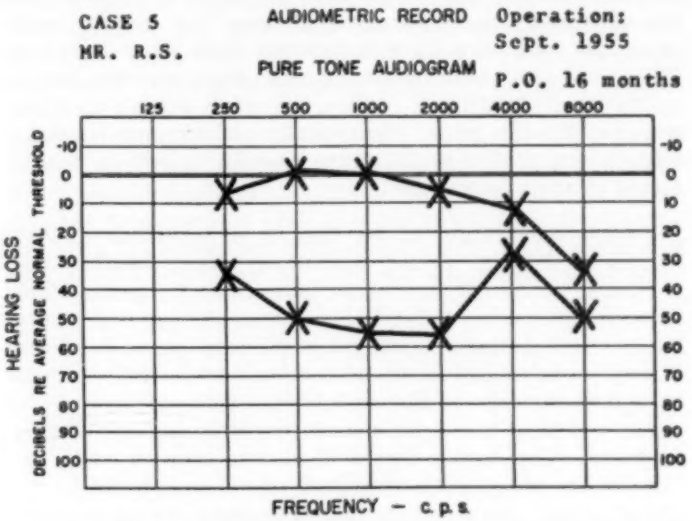


Fig. 5. Post-operative congenital atresia with skin graft applied to stapes capitulum.

this way we hoped to obtain hearing results in "A" cases comparable to those demonstrated in other radical ear procedures. We hesitated reporting our results until we were certain that osteogenesis would not occur as a result of this change in technique, and to date there has been less frequent closure, that is, it has remained below 2 per cent of all cases (A,B,C) operated. Certainly the results have improved, the post-operative vertigo and nystagmus have been markedly reduced, and most patients hear immediately and continue to hear despite the presence of packing.

TECHNICAL PROBLEMS.

At this point it is worth mentioning the slight variations in our technique from beginning to end.[1] Removal of skin during the endaural incision occasionally results in cicatricial stenosis; scar tissue once formed is difficult to treat. We make our incision a little deeper in the external canal, leaving more skin attached to the auricle in order to sew it to the periosteum overlying the mastoid process. By this method the raw area which usually epithelizes last gets an early start and soon joins the skin growing from the pedicle flap. We do not graft the intervening area, since granulations fill in the mastoid cells and produce a smooth surface on which the new skin can grow. Occasionally revisions are necessary with the use of skin grafts, if the mastoid tip cells become infected at some later date.[2]

During preparation of the flap it is important to leave smooth periosteum as the presenting tissue. Rather than cut out any adherent bone chips, these chips are gently teased away, and in this way bleeding is decreased from this source.[3] Suction and irrigation, using Lamp's solution, is continued through endchondralization of the horizontal canal in order to protect the cells of the cavity from death, as occurs with saline.[15] Using the Zeiss microscope[4] the fenestra is next prepared. The Jordan-Day drill at this stage is really too fast for the preparation of a good cupola and should be run at half speed. An eccentric burr indicates a poorly functioning drill handle and makes fenestration a dangerous procedure. The mastoid and middle ear cleft are then dried as much as possible, bleeding is controlled and the packing prepared, prior to removal of the endosteal lid. Pressure against the dome of the cupola is preferable to elevation at the so-called black line area during the removal of the lid, preventing depressed chips and often a clean sharp edge results. Any chips present are removed with a small curette, or picks, and the fenestra is squared. If this window is made over the surgical dome of the vestibule, damage of the nerve filaments to the ampulla of the horizontal canal is possible and this, of course, is undesirable. No effort is made to preserve excess endosteum and, of course, with this

technique preservation beyond the borders of the lip is impossible.

If bleeding occurs from any arachnoid vessels, producing a clot in the mesh, a few drops of solution are used in the attempt to remove it. If a chip is lost in the mesh the same procedure is employed, but manual removal is avoided. We feel that in all cases blood enters the vestibule to a greater or less degree, and as Lempert has observed, if the flap is again elevated from the fenestra some blood staining is always present in the perilymph. Before the use of the high power microscope, without doubt many chips fell into the vestibule unnoticed, and most of those cases obtained a satisfactory hearing result as our observations have shown.[5] The flap is quickly mobilized and placed in position to prevent outside blood from entering the window. Paraffinized silk is placed over the fenestra as a pack in order to keep the flap in contact with the edges and hastens healing by the formation of fibrous tissue to unite the endosteal membrane to the flap.[1]

Mesh packing fixes the silk in position, and gelfoam is used to line the mastoid bowl. After suturing the conchal margin of the auricle to the periosteum and temporal muscle, to cover any exposed auricular cartilage, a penrose drain and cellulose sponge are inserted.

RESULTS.

In the years 1954 and 1955, 293 cases were operated. We picked the first 100 ideal or "A" cases, with follow-up records over the two-year period. An ideal case was classified as an air conduction level of 40 to 50 db., and a bone conduction curve of 10 db. or better for the speech frequencies. An analysis of the 100 ideal cases showed 100 per cent obtained a 30 db. level or better. They were classified as a "good" result if better than 20 db., and "fair" if the conversational frequencies lay between 20 and 30 db. It was noted that in a few cases where no irrigation was used, an improvement in the upper frequencies was obtained. The majority of good results closely approximated or exceeded the bone conduction curve, and gave a comparable result to the best stapes mobilization cases.

Fig. 6 shows the results of continuous irrigation vs. minimal, and cases designated as "no irrigation" where solution did not come in contact with the membranous duct. A record of visible chips and blood clots, which could not be removed are separately noted. The combined results of minimal irrigation and no irrigation show that 76.4 per cent obtained a level better than 20 db., whereas with continuous irrigation

PRE-OP. SPEECH FREQ. 47.3 db AVERAGE — POST-OP. SPEECH FREQ. 18 db AVERAGE

100 IDEAL CASES - ALL ABOVE THE 30 db LEVEL POST-OPERATIVELY

	NO. OF CASES	GOOD✦ RESULTS	PERCENTAGE
EXTENSIVE IRRIGATION	28	11	39.3%
MINIMAL IRRIGATION	57	45	78.9%
NO IRRIGATION	15	10	66.6%
TOTAL	100	66	66%
(USING ZEISS SCOPE) BLOOD CLOT LEFT IN FENESTRA	19	8	42%
CHIPS LEFT IN FENESTRA	6	2	33%

✦ GOOD - INDICATES LEVELS ABOVE 20 db.

Fig. 6. Above table shows results of irrigation versus no irrigation in 100 ideal cases. All cases were at the 30 db. level or better; "good" cases represented as 20 db. or better. No closures in this series.

only 39 per cent were in this category. Minimal irrigation with removal of bone dust, bone chips and blood, showed that 79.9 per cent were at the 20 db. level, and with no irrigation 66 per cent were at this level.

It must be noted, however, that the division of the cases is not equal, since 28 cases were continuously irrigated; 57 with minimal irrigation and only 15 with no irrigation.

It has been explained previously that continuous irrigation was occasionally necessary where excess bleeding developed, at some stage, and could not be stopped easily without irriga-

tion. While blood clot and chips in the perilymph space are very upsetting, it is seen that their presence does not preclude a good result; 42 per cent that showed visible chips over the ampulla or with chips entering the vestibule and disappearing, obtained a level better than 20 db. The same was true of a large clot settling in the arachnoid mesh that could not be washed away; 33 per cent of these cases obtained a 20 db. level or better.

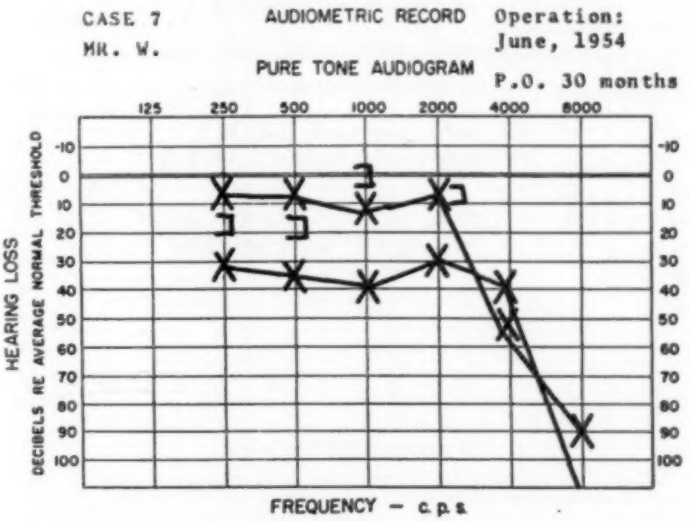


Fig. 7. Level of 6 db. using no irrigation, from pre-operative 35 db.

Fig. 7 shows a 6 db. level after using the dry technique from a pre-operative 35 db. level (note the bone conduction curve). Fig. 8 shows an 8 db. level from a 40 db. level which, it is noted, lies over the B.C. level. No irrigation was used in this case. Fig. 9 shows a good result wherein the right ear was operated in 1952, and a clot was left in the fenestra with a moderately large chip in the arachnoid mesh that could not be removed, thereby depressing the ampulla at closure. The left ear was operated in November, 1955, and

minimal irrigation was used; again, a blood clot could not be removed. Our bone conduction classed this case as a "B" case with B.C. in the upper speech frequencies at 30 db. The precision audiometer B.C. is shown with levels of 0 and minus figures. Fig. 10 also shows a case operated September, 1955, with a blood clot that could not be removed, together with

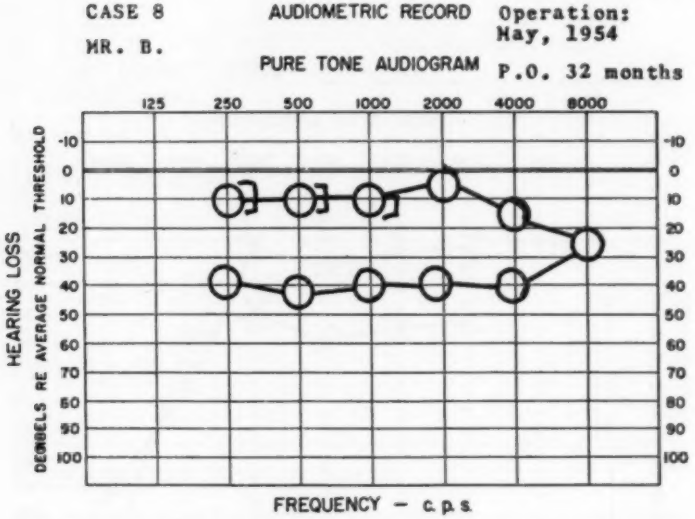


Fig. 8. A post-operative level of 8 db., using no irrigation. Note bone conduction level of 10 db.

the latest audiogram. Fig. 11 is shown to note a result of 5 db. with an otosclerotic focus involving the horizontal canal which was removed with the cupola; 18 months have elapsed since operation. Fig. 12 shows a slide of this focus.

EVALUATION OF RESULTS AND DISCUSSION.

It is noted that out of the 100 ideal cases, all obtained a practical level of hearing. This would suggest that ideal cases can be advised of better than nine chances out of ten of success. A failure in an ideal case may still occur, due

to faulty selection from false bone conduction or false speech reception readings. We still advocate the use of tuning forks and repeated pre-op. audiograms for confirmation of results. As Guild[16] has stated, more than one otosclerotic lesion may occur in one ear, and this incidence was present in 24 per cent of 113 ears that he examined; therefore failures

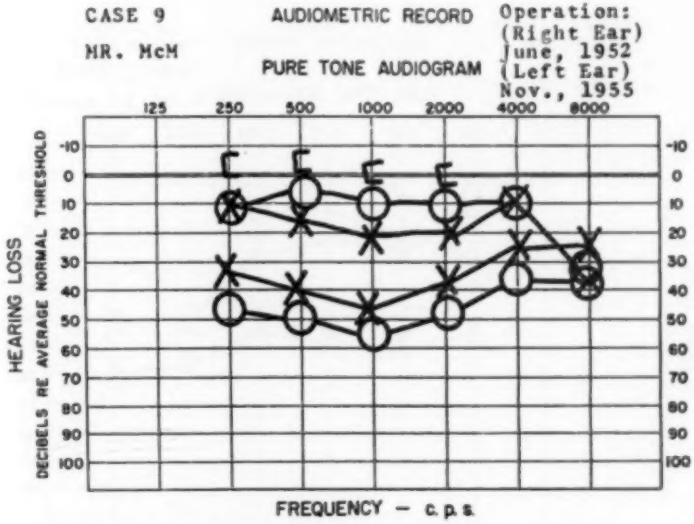


Fig. 9. Both ears fenestrated: right—June, 1952, continuous irrigation; left—Nov., 1955, intermittent irrigation. Blood and minute chips in both fenestra at closure.

may be attributable to this second or third lesion in the round window or elsewhere. Blood sludge occurring in the arachnoid mesh vessels during observation with 40x magnification was often noted, but whether or not this is of any significance cannot be definitely stated. The fact that clots are present and are no doubt absorbed without injury to the subsequent function of the horizontal canal makes us doubt the importance of blood as the sole causative factor in serous labyrinthitis.

In 1951 we experimentally made fenestras in the parietal

bones of rats' skulls and the following statement was made:[1] "Our result with the blood in the fenestra were rather inconclusive. As far as bone growth is concerned, the fenestra containing blood clot showed an initial osteogenesis that was slower than those that were free of blood at closure." Resultant early fibrosis at the fenestra and at its margins is desirable. This fibrous tissue is not osteogenic, since only

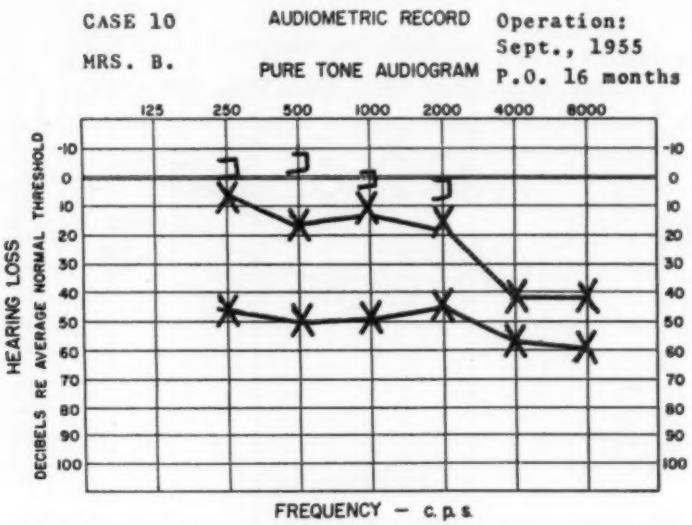


Fig. 10. A similar case with solid blood clot over the ampulla in the arachnoid mesh, audiogram 16 months post-operative.

the osteogenic cells of the bone can produce bone. Fibrous attachment of the endosteum and flap at the margin of the window limits the extension of new bone growth, at this site. In the same paper delivered at the Otosclerosis Study Group meeting, it was stated that our observations showed that bone dust and small chips, while setting up a foreign body reaction, were absorbed. Bone cannot survive without a blood supply and must contain living osteogenic cells to do so. Bone dust and bone chips lying at the fenestra rim is another story—acting as a bridge to encourage closure. We

do not in any way advocate leaving either blood or bone dust if it can be removed with ease.

House[6] reported in 1951, 55 per cent of his cases with a loss of 30 db. or less after two years, and Shambaugh[17] stated that 74.4 per cent were completely rehabilitated at two years. Campbell[5] reported in 1954, 130 successful ideal cases

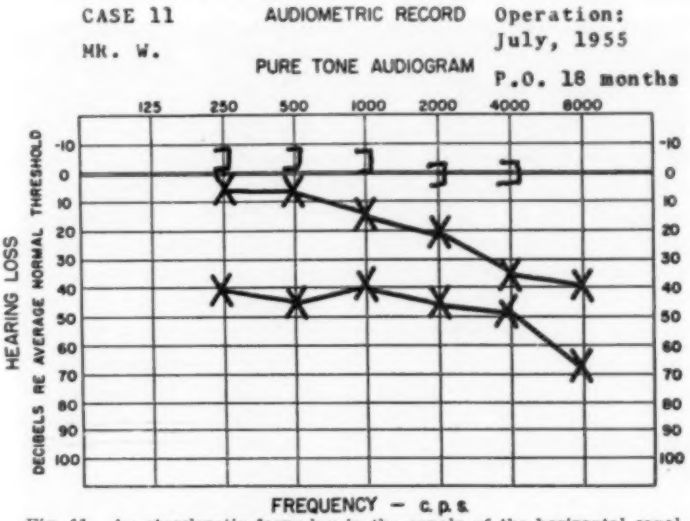


Fig. 11. An otosclerotic focus lay in the cupola of the horizontal canal. No irrigation was used.

with a preoperative level of 49.2 db. and an average decibel loss of 28.9 after two years, and 27.6 after five years. Our result in the 100 ideal cases show an average preoperative level of 47.3 db. for the three speech frequencies and an average postoperative result of 18.0 db. We conclude that the slightly better results in our figures are due to the "dry" technique and the use of Lamp's solution when irrigation is used.

SUMMARY.

The results of 100 ideal or "A" cases are presented with a

post-operative average db. loss of only 18 db. for the three speech frequencies. Minimal irrigation is felt to be superior to continuous irrigation, and discontinuing the use of normal saline in this operation is stressed. An attempt is always made not to use any solution after removal of the fenestral lid, if at all possible. A reduction in post-operative vertigo using continuous irrigation with Lamp's solution was noted,

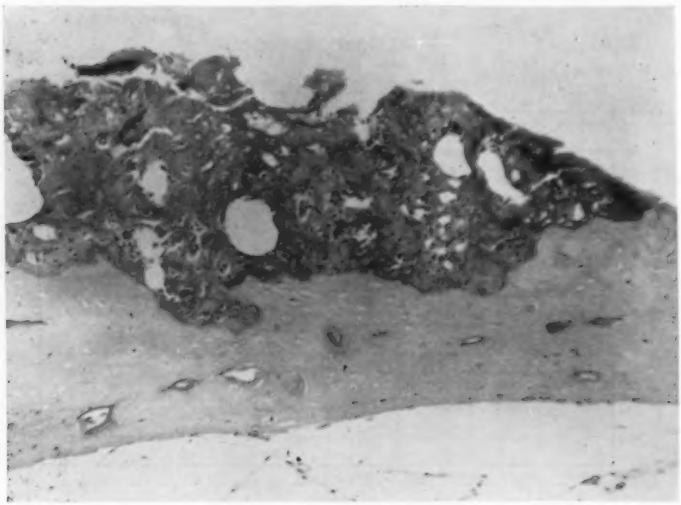


Fig. 12. Photomicrograph, low power 80X, of the cupola or lid showing the endosteum and the enchondral layer with the otosclerotic bone in part of the area shown.

with a further decrease in symptoms using minimal irrigation. There has been no increase in the closure rate as was expected, since this remains about 1 per cent. Gross blood and blood staining, while not desirable, may produce a mild labyrinthitis, but does not appear to affect the final result to any great extent. Bone chips at the margins are removed gently, but manipulation of the duct or mesh is to be condemned. The cupola technique has the advantages of decreasing the number of chips, although chips still fall into the vestibule in a few cases despite the use of careful tech-

nique. The microscope should be used by all otologists carrying out this procedure, so that loose chips may be removed from the fenestral rim without trauma to the membranous canal.

CONCLUSION.

An attempt has been made to analyze the successful cases. Fenestration surgery must be accepted as an operation which at the present time gives the highest percentage of success in ideal cases. The patient will hear as well or slightly better than he would with a hearing aid, and it is hoped by using this method that secondary cochlear degeneration, as a result of surgical interference, may be minimized by the continual adherence to the prevention of chemical and mechanical trauma to the delicate inner ear cellular structures. The stapes operation has been adopted by the authors as a primary operation in most ideal cases with the agreement that the patient will undergo a fenestration procedure if possible, should the preliminary operation be unsuccessful. An effort has been made to present an honest appraisal of results obtained, using this technique.

REFERENCES.

1. Sullivan, J., and Smith, B.: Causes for Failure in Fenestration Surgery. Supp., *Trans Amer. Acad. Otol.*, 24-33, July, 1951.

2. Lempert, Julius: Improvement of Hearing in Cases of Otosclerosis; a New One-stage Surgical Technique. *Arch. Otol.*, 36:23-46, July, 1942.

3. Lempert, J.: Lempert Fenestra Nov-Ovalis for the Restoration of Practical Unaided Hearing in Clinical Otosclerosis; its Present Status. *Med.*, 40:320-326, April, 1947.

4. Adin, L. E., and Shambaugh, G. E., Jr.: A Study of Long Term Hearing Results in Fenestration Surgery. *A.M.A. Arch. Otol.*, 53:243, March, 1951.

5. Campbell, E. H.: Long Term Results with the Fenestration Operation. *Arch. Otol.*, 60:265-276, Sept., 1954.

6. House, H. P.: Long Term Results of Fenestration Surgery. *Trans. Amer. Otol. Soc.*, pp. 178, 1951.

7. Cawthorne, T.: Review of Surgery of Otosclerosis. *Proc. Royal Soc. Med.*, 40:320-326, April, 1947.

8. Sullivan, J. A., and Smith, J. B.: Ten Years Experience with the Fenestration Operation. *Proc. Fourth Internat. Cong. Otolaryngol.*, London, July, 1949.

9. Rosen, S.: Mobilization of the Stapes to Restore Hearing in Otosclerosis. *New York Jour. Med.*, 53:2650-2653 1953.

10. WOLFF, DOROTHY: Otosclerosis; Hypothesis of Its Origin and Progress. *Arch. Otol.*, 853-867, Dec., 1950.

11. WEVER, E. G.; LAWRENCE, M., and SMITH, K. R.: The Middle Ear in Sound Conduction. *Arch. Otol.*, 48:19-35, 1948.

12. SHAMBAUGH, G. E. JR.: A Modified Fenestration Technique; Analysis of Results in 141 Consecutive Operations. *Arch. Otol.*, 36:23-46, July, 1942.

13. LAMP, C. B., JR.: Reduction in Post Fenestration Vertigo by Use of Isothermal Isotonic Irrigation Technique. *Proc. Staff Meet., Mayo Clinic*, 27:565-568, Dec. 17, 1952.

14. POMERAT, C. M.: Recent Observations on Living Human Cells with Cinematographic Technique. *Ann. Meet. Triol. Soc.* (Film Presentation), Hollywood, Fla., March, 1955.

15. SHAMBAUGH, G. E.: Technical Problems in the Surgical Treatment of Otosclerosis. *Jour. Int. Coll. Surg.*, 25:6, June, 1956.

16. GUILD, S. R.: Incidence, Location and Extent of Otosclerotic Lesions. *Arch. Otol.*, 52:848-852, Dec., 1950 .

17. SHAMBAUGH, G. E.: Fenestration Operation for Otosclerosis; Experimental Investigation and Clinical Observations in 2100 Operations Over a Period of 10 Years. *Acta. Otol.*, Supp. 79, 1949.

INSTITUTO MEXICANO DE LA AUDICION Y EL LENGUAJE.

The Mexican Institute of Hearing and Speech will offer an inter-American training course in Spanish for teachers of the deaf February 1 to December 31, 1958. Registration for the 1958 course closes October 31, 1957. This course will be held annually and will be under the auspices of Dr. S. Richard Silverman of Central Institute for the Deaf, St. Louis, Mo.

For further information write Professor Dr. Pedro Berruecos Tellez, 141-a Progress Street, Mexico 18, D.F.

A NEW CONCEPT OF AUDITORY SCREENING.*†

HOWARD P. HOUSE, M.D.,
and
ARAM GLORIG, M.D.,
Los Angeles, Calif.

The need for rapid auditory screening tests to measure the hearing of large numbers of persons is more urgent today than ever before. Conservation of hearing programs for school children, industrial personnel and the military have aroused an unprecedented interest in rapid methods of testing hearing.

The two methods currently used to measure hearing are basically different; one gives a record of the auditory threshold; the other screens at fixed intensity levels and gives only pass or fail results. Either of these methods, as currently applied, is too time consuming to satisfy the requirements of rapid testing of large groups. The screening method, however, shows more promise of being adapted for rapid testing than does the threshold method.

PRESENT METHODS OF SCREENING.

Screening tests are performed to determine the presence of a possible hearing impairment or to detect a change in hearing status. These tests may be performed manually or automatically and may be given individually or in groups. They usually are made by setting the attenuator of a pure tone audiometer at the 15 or 20 db. level and recording a pass or fail response at each frequency. This method is known as the sweep check method of screening.

The sweep-check test has become more or less standard throughout the country, particularly in school testing pro-

*Read at the meeting of the Western Section American Laryngological, Rhinological and Otological Society, San Francisco, Calif., Jan. 21, 1957.

†From the Department of Otolaryngology, University of Southern California School of Medicine.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 29, 1957.

grams. For several reasons group methods of screening are not so commonly used as the sweep-check method. The most important of these reasons are:

1. Group screening equipment is costly because it requires multiple sets of earphones.

2. Finding a "quiet-room" large enough to test the required number of subjects is always difficult.

3. Maintaining the flow of subjects in groups large enough to produce optimum efficiency of group screening is extremely difficult in the military forces or in industry.

Group techniques are impractical in industrial or military situations for the reasons listed above; yet the need for rapid testing of hearing of large numbers of persons in industry and in the armed forces is urgent: some type of rapid, individual, pass-fail test must be provided to meet their requirements.

THE DEVELOPMENT OF A NEW CONCEPT OF AUDITORY SCREENING.

As large amounts of auditory data accumulated in our files it became apparent that the thresholds at 4000 c.p.s. were, in many records, higher than the thresholds at other frequencies. To check whether or not this was generally true, we analyzed some audiometric records drawn from the record files of industrial workers, of a general population study, and of office patients. An additional 1500 audiometric records of school children were also studied. A brief report of the results of these analyses is given below:

AUDIOGRAM SAMPLE NO. 1.

Eleven hundred and twenty-eight audiograms, selected at random from 11,000 records in Dr. House's files, were classified according to diagnosis; 16.6 per cent of these patients had presbycusis, and 34.1 per cent had otosclerosis. The remaining 49.3 per cent included all other causes of hearing impairment, and was classified as "miscellaneous." Analysis of these audiograms revealed: *1.* 98.2 per cent of the cases that showed a 15 db. loss at 4000 c.p.s. in either ear had no

greater loss at any lower frequency; *2.* 99.1 per cent of the cases that showed a 15 db. loss at either 4000 or 2000 c.p.s. had no larger loss at any other test frequency; therefore, if one tests with 4000 c.p.s. at a screening level of 15 db., only 1.8 per cent of the cases will show a greater loss in any of the lower frequencies. If 2000 c.p.s. is included in the test, the percentage is reduced to 0.9 per cent.

AUDIOGRAM SAMPLE NO. 2.

Audiograms of 1,971 male aircraft employees were analyzed; 99.2 per cent of the audiograms showed no greater loss at any frequency below 4000 c.p.s. than the loss found at 4000 c.p.s.

AUDIOGRAM SAMPLE NO. 3.

A similar study of the audiograms of 1,749 males who participated in the 1954 Wisconsin State Fair Hearing Survey revealed that 97.4 per cent had no greater loss at any frequency below 4000 c.p.s. than the loss recorded at 4000 c.p.s.

SCHOOL TEST SAMPLE.

Through the cooperation of the Los Angeles Board of Education, one of the Los Angeles City school audiologists screened 1,500 school children individually at 4000 c.p.s. This single frequency test was followed by the sweep-check test regularly used in the Los Angeles school system. (This sweep-check tests each of five frequencies at the 15 db. level). All failures found by either the single tone test or the sweep-check technique were then tested individually by the usual threshold method.

The results were that 93.7 per cent of the children passed the single frequency test and 94.9 per cent passed the sweep-check method. In this comparison the single frequency screening test was 99.5 per cent as accurate as the sweep-check test when given to the same children under similar conditions.

As an extension of the study 500 of the 1,500 children

were screened at both 2000 and 4000 c.p.s. to determine whether a greater accuracy would result when two frequencies are used. No noticeable increase in accuracy resulted. It is felt, however, that if 2000 c.p.s. is included, fewer unnecessary referrals of school children will be made because of the insignificant "congenital dips" frequently found at 4000 c.p.s.

These studies indicate that for appropriate groups one can quite accurately predict that losses at any standard test frequency below 4000 c.p.s. will not be more than the loss found at 4000 c.p.s.; therefore, it appears on the basis of these findings that single frequency screening at 4000 c.p.s. will accomplish essentially the same results as any presently used screening method.

The study of 1,500 school children was made with an instrument built by A. M. Brooks Company, of Los Angeles. This instrument known as the Oto-chek is a simple battery-powered transistorized screening audiometer. There are two basic models of the Oto-chek: a single frequency screener and a double frequency screener. The first is designed to test hearing at 4000 c.p.s., the other at 2000 and 4000 c.p.s. Either model may be obtained with single or double earphones, and with output levels of 15 and 30 db., or 20, 35, and 50 db. The frequencies and levels are fixed. The earphones are energized by means of push buttons labeled in db. of hearing loss according to the output level. When binaural earphones are used, the right or left earphone is selected by a rotating two position switch. The entire circuit is housed within a metal box measuring 5½″x4″x2″. The Oto-chek is powered by a Mallory mercury cell type battery and energizes a dynamic type earphone. The earphone is coupled to the ear by a standard MX-41/AR type sponge rubber cushion. The entire instrument weighs betwen one-and-a-fourth and one-and-a-half pounds, depending upon whether there are one or two earphones (see Figs. 1, 2).

ADVANTAGES OF SINGLE AND DOUBLE FREQUENCY SCREENING TESTS.

Single and double frequency screening tests are well suited

to use in schools, industry, the armed forces, and in doctors' offices.

School Programs.

For school testing programs the double frequency method offers many advantages:

Fig. 1. Double frequency (2000 and 4000 c.p.s.) screening audiometer for school and office use. Available with double or single earphones.

1. Many more children can be tested in a given time by the same personnel.

2. The fatigue and distraction normally encountered in testing young children is eliminated since each test requires but a few seconds.

3. Sound-treated test areas are not necessary. Hearing the 2000 or 4000 cycle tones at screening levels is not affected by

the usual ambient noise levels in quiet school rooms; ordinary classrooms can be used for this test.

4. Specially trained audiological personnel are not essential to give this screening test. Highly trained school audiologists can, therefore, be released to devote more time to threshold testing of children who fail the screening test.

Fig. 2. Single frequency (4000 c.p.s.) screening audiometer for industrial use. Available with double or single earphones.

Industrial Program.

The single frequency screening test makes a practical program of follow-up tests available to industry for the first time. Instruments for making the follow-up tests can be placed at various points in the plant; in a quiet area near the time clock, for example. Here men can be tested quickly and accurately just before or just after punching their time

cards. This procedure makes it unnecessary for employees to travel to and from the medical department for follow-up tests, thus saving many minutes of work time for each employee.

Military Program.

Few, if any, inductees are now tested for hearing defects. When a man is inducted into military service he is medically examined on a production line basis: Each part of the examination is made in less than a minute. Any current accurate hearing test takes considerably longer than one minute and would be a bottle-neck in the examination program. The single-frequency screening test is particularly suitable for use here and would introduce into the induction examination, also for the first time, an accurate auditory test.

Doctors' Offices.

The double frequency Oto-chek provides a rapid, accurate and inexpensive means of detecting possible hearing impairment during routine physical examination performed by pediatricians, internists and general practitioners.

In the interests of hearing conservation it has long been advocated that every patient who consults an otolaryngologist should, as a matter of routine, have a hearing test. For many reasons these routine tests have not proved to be practical in the past. Now, however, such tests are coming into general use. Some otolaryngologists have a double frequency Oto-chek on the wall of their treatment rooms. The nurse quickly checks the hearing after the patient is seated. If the patient hears 4000 c.p.s. at 15 db., it may be assumed that he or she has essentially normal hearing. If a patient fails to hear the test tone at a higher level, for example, 35 db., a complete threshold audiogram can then be recommended.

SUMMARY.

The usual screening audiometry methods are not completely suitable for use in school, military, and industrial testing

programs, and the need for a new hearing test has been evident for some time.

Investigations of large numbers of audiograms revealed that in approximately 99 per cent the hearing loss at 4000 c.p.s. was at least as great as the loss at any lower frequency. Several studies were conducted to determine the generality of this finding.

On the basis of the results of several studies we recommend that testing at 4000 c.p.s. be used as a screening test in schools, industry, the military forces, and in doctors' offices. Such a screening method has none of the disadvantages of other methods and has many advantages. For example:

1. Ordinary quiet rooms (offices, first aid rooms, etc.) may be used for testing.

2. The test requires only a few seconds to complete; saving time and preventing fatigue.

3. The intrument is inexpensive, light weight and very durable.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY HOME STUDY COURSES.

The 1957-1958 Home Study Courses in the basic sciences related to ophthalmology and otolaryngology, which are offered at the American Academy of Ophthalmology and Otolaryngology, will begin September 1 and continue for a period of ten months. Detailed information and application forms can be secured from Dr. William L. Benedict, executive secretary-treasurer of the Academy, 15 Second Street S. W., Rochester, Minn. Registrations should be completed before August 15.

DIFFERENTIATION OF INTRACRANIAL AND PERIPHERAL VESTIBULAR LESIONS.*

WALTER H. JOHNSON, Ph.D.,
(By Invitation)
and
J. BRYDON SMITH, M.D.,
Toronto, Canada.

INTRODUCTION.

A difficult decision which frequently confronts the otologist is to establish whether the lesion is localized in the peripheral end-organ or has an intracranial origin. Although it is often considered unwise to decide on a central lesion when symptoms referable to the VIIIth Cranial Nerve are the only ones which can be identified; nevertheless it has been established that this does occur. For example, Hallpike and associates[1] have identified tumors of the posterior part of the temporal lobe by certain characteristics of response to caloric stimulation of the semicircular canals, by a test which they have termed "Directional Preponderance," and occurring toward the involved side. Nevertheless, close cooperation with the roentgenologist, and especially the neurologist, is always essential. It is the object of this presentation to describe the studies which are currently in progress in this regard at the Vestibular Research Clinic at St. Michael's Hospital, and developed with the cooperation of the Department of Otolaryngology of the University of Toronto.

It might be pointed out that the procedures which we have adopted are the result of having visited such specialized clinics as those at the University of Utrecht in Holland, King's College Hospital, and the National Hospital for Mental Disease at Queen's Square in London, and also those of many of our colleagues in the United States, who have made such excellent contributions in the diagnosis and treatment of vestib-

*Presented at the meeting of the Eastern Section of the American Laryngological, Rhinological and Otological Society, Inc., Toronto, Can., Feb. 1, 1957.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 23 1957.

ST. MICHAEL'S HOSPITAL
Ear, Nose and Throat Clinic

History No._____

Date_____

Vestibular Function Tests

Name: Address:

Service: Age: M.F.

History of Present Illness (Relevant Data)

1. Hearing Tests:

a) Audiogram: Indicate loss R. 250 500 1000 2000 4000 8000 CPS
L.

b) Recruitement:

2. Spontaneous Reactions:
Drift Reaction:
Past-Pointing:
Adiadochokinesis:
Nystagmus: a) Head upright
b) Head hanging
Walking (eyes closed)
Falling: Romberg Sign
Effect of Head Position:

3. Tilt Test:

4. Electric Tests:
(a) Falling Test: R. L. (b) Chronaximeter Test: R. L.

5. Caloric Tests:

	Left				Right			
	P-P	Nyst.	Nausea	Falling	P-P	Nyst.	Nausea	Falling
a) Dundas-Grant:								
b) Ice Water:								

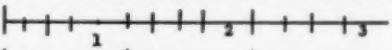
Fig. 1. Front.

ular disease. After having examined approximately 600 patients referred because of complaints of dizziness, it is fully appreciated that much remains to be learned, and that the need for investigation of labyrinthine disorders merits attention, a fact which is so thoroughly appreciated by Dr. Sullivan that he has done much to pioneer progress in this field, as in other aspects of otology.

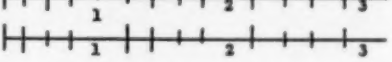
Name

c) Tap Water: Time from beginning of irrigation

30°C R L



44°C R L



d) Simultaneous Bilateral Irrigation:

6. Turning Tests:	NORMAL RESPONSES	Remarks
a) Rotating Chair	Yes ( ) No ( )	
b) Rotating Stretcher	Yes ( ) No ( )	

7. Other Cranial Nerves:

I	VII
II	IX
III, IV, VI	X
V	XI
	XII

8. Other Tests (Fistula test etc.):

9. Oculokinectic nystagmus Test:

Summary and Impression:

Fig. 1. (Back) History and examination sheets which are placed on patients hospital chart (or mailed to referring physician).

PROCEDURE AND DISCUSSION.

A. History.

In order to insure uniformity of procedure we have established charts as shown in Fig. 1. As indicated, sufficient space for a careful history is included. Since the patients referred to this clinic complain of dizziness, unsteadiness, apparent displacement of surrounding objects out of their normal spatial relationships, etc., an accurate description of such symptoms is first obtained. An attempt is thus made to determine whether during the attacks the patient experiences actual rotation, either of himself or of surrounding objects, and whether such attacks are associated with any symptoms referable to the cochlea; such positive findings

point to a peripheral origin. It should be borne in mind that cardiovascular syncope may often be described by the patient as dizziness, and if the ensuing attacks are accompanied by unconsciousness, blurring or double vision, then the symptoms are indicative of central origin. Evidence of auditory recruitment may be obtained when taking the history, since distortion of sounds (*e.g.* radio music) may be the result of appearing unpleasantly loud in the involved ear, and is taken as evidence of pheripheral origin. Anything immediately preceding or accompanying the attacks of vertigo are carefully noted, since the patient may report vertigo when lying in bed with the head in a specific position. If such is the case, the patient should be questioned as to the duration of the attacks, since if these are brief, the findings are indicative of peripheral origin.

The presence of headaches may or may not be of differentiating value, although localized headaches may indicate a central origin, while diffuse sensation of fullness of the head often in the temporal region can be suggestive of end-organ lesion. History of head injury is recorded, and it should be borne in mind that fracture through the base of the skull may well involve the petrous portion of the temporal bone with consequent trauma of the membranous labyrinth or hemorrhage into the vestibule.

A recent report involving controlled experiments with animals in this regard established that blows on the frontal region are capable of causing definite lesions of the lateral vestibular nuclei in the brain stem, as determined by direct evidence from histologic sections.[2]

A record is made of any infections reasonably associated with the time of onset of vertigo, since in the case of upper respiratory infection the sudden onset of vertigo without cochlear involvement is indicative of vestibular neuronitis, whereas cerebral meningitis may result in destruction of the central vestibular nuclei.

Toxic conditions affecting the end-organ should be looked for by questioning the patient for evidence of gall-bladder disease, allergy, etc.

B. Spontaneous Manifestations.

Ability to maintain balance when standing still or walking with the eyes closed is a valuable test. If falling does occur in a direction which depends upon the position of the head it is indicative of peripheral origin. If the examination happens to be made during an attack of spontaneous nystagmus and the falling occurs in the direction of the slow component it indicates a peripheral lesion, while if in the direction of the fast component it is suggestive of a central lesion.

Since cerebellar lesions may be confused with peripheral vestibular lesions, muscle coordination tests, such as adiodochokinesis, nose-touching, etc., are essential. The "tilt test" of Tait and McNally[3] has been utilized also in differentiation of cerebellar and labyrinthine ataxia, since lack of ability to maintain equilibrium in response to slow tilt is indicative of labyrinthine origin.

In examining for spontaneous nystagmus we follow the procedure as advocated by Cawthorne and Hallpike,[4] especially in regard to positional nystagmus. A modification of Frenzle's goggles is used at this time in order to facilitate detection of fine nystagmoid movements.[5] Movements of the two eyes are compared, since dissociation of the nystagmus indicates a central origin. The characteristics of any nystagmus should be noted (direction, amplitude and duration). Thus for example, spontaneous vertical nystagmus is indicative of a central lesion involving that part of the brain stem lying between the pons and the corpora quadrigemina. In this regard, it has been claimed[6] that temporal lobe abscess instigates vertical nystagmus when rupture occurs into the ventricle.

The direction of the nystagmus is determined, since in peripheral lesions this may change depending upon the course or the duration of the lesion. In central vestibular lesions, however, the quick phase of the nystagmus is usually towards the side involved.

Another important factor recorded at this stage is a determination of whether the spontaneous nystagmus is accom-

panied by subjective sensations of false movement and autonomic disturbances such as nausea, vomiting, etc. If such symptoms do not occur when the nystagmus is present, regardless of the direction in which the patient looks, it may be considered indicative of a central lesion; furthermore qualitative changes are indicative of a central lesion.

Full details as to procedure recommended for a determination of the presence of positional nystagmus has recently been well described by Hallpike.[4] Details of the test will not be repeated here other than to point out that we have found it to be present in many of our cases and consider it a valuable test for differentiation between central and peripheral vestibular lesions. If the nystagmus is fatiguable and of short duration, it is indicative of a peripheral lesion of the utricle (benign paroxysmal positional nystagmus), whereas if the reverse conditions hold true it is indicative of a central lesion.

C. Hearing Tests.

Routine audiograms are always carried out prior to any caloric or rotational stimulation which might interfere with the acuity of the test. If recruitment is present it is indicative of end-organ vestibular disease when associated with vertigo. In vestibular neuronitis recruitment is conspicuous by its absence. As to procedure, the loudness balance test, as advocated by Fowler and modified by others is used. The significance of a cochlear fatigue test to determine recruitment is underway at the present time.

D. Caloric Tests.

We have used various types of caloric stimulation as advocated by many authors, and use the procedure described recently by Hallpike (1956). Failure to produce a response by mild stimulation is followed by the application of water at 20°C. or eventually ice water if necessary. Since vestibular recruitment has been found to exist,[7] failure to produce a response by one application of ice water is followed by another, and if necessary three attempts are made. If these are ineffective, continuously flowing ice water or cold air, using

the Dundas-Grant tube is applied. Perhaps the most significant contribution of the procedure advocated by Fitzgerald, Hallpike and Cawthorne has been the introduction of the term "Directional preponderance," whereby a more vigorous response occurs in one direction regardless of whether hot or cold water is used. Directional preponderance has been found by these authors to be directed towards the involved side in tumors of the posterior part of the temporal lobe. Contralateral preponderance, however, has been reported toward the opposite side in brain stem involvement.

The nature of the responses are noted, since qualitative changes are likely to indicate peripheral lesions of the vestibular system.

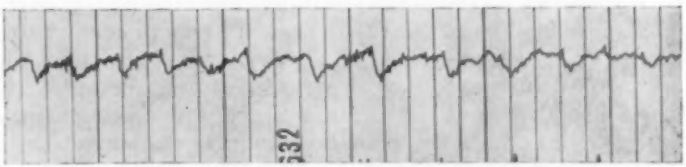


Fig. 2. Electronic recordings of nystagmus following rotation.

We now have evidence that the characteristics of the slow component of nystagmus are extremely significant in differentiating between central and peripheral lesions. In order to make such recordings, special equipment is required which necessitates considerable skill in operation. The significance of such findings (see Fig. 2) will be presented at another time.

Simultaneous bilateral calorization is advocated when unilateral stimulation shows equal left and right-sided sensitivity. This test can be of value[8] in the differentiation between infra- and supratentorial tumors. Nystagmus of second or third degree must be produced before the result is considered positive, in which case a posterior fossa lesion is indicated. Forward and backward subjective sensations of directional movement are claimed by Fischer and Waudack[9] to indicate a lesion of the red nucleus.

E. Electrical Stimulation.

Probably the best known vestibular test by this means is the "Galvanic reaction," whereby a weak electric current causes falling when passed between the manubrium of the sternum and the external auditory meatus (or mastoid process). It is useful in determining the integrity of the vestibular reflex arc. Thus, lack of response to caloric stimulation but with a definite response to electrical stimulation indicates that the central vestibular nuclei are intact. This is a reasonable result, since degeneration may proceed centrally from the end-organ as far as the first neuron in the internal meatus. Simultaneous bilateral galvanic stimulation may also be used to show differences in excitability of the reflex arc on either side.

A relatively recent development has been the measurement of the excitability of the VIIIth cranial nerve in quantitative terms by a determination of its *chronaxie* (time in milliseconds for current to flow in order to excite). Bourguignon has found that the VIIIth cranial nerve lends itself particularly well to such a determination, and has the longest chronaxie of any nerve (10 mm. secs.). This value is reported to remain normal in central diseases while noticeable changes occur in peripheral vestibular lesions. Rius and Ferrero report that chronaxie measurements can determine degenerations of the second and third neurones with intact first vestibular neuron. The significance of this procedure is under investigation at our clinic.

F. Ocular Nystagmus.

Another test used in the differentiation of central and peripheral lesions consists of inducing optokinetic nystagmus with a rotating drum. A normal response consists of ocular nystagmus in the opposite direction to that of the rotating disc. A reversal of this response indicates ocular or central origin.

G. Rotation.

Since it has been established that Ewald's Law does not apply to the human[10] rotation tests, even though more physio-

logical than caloric tests, have become less common than formerly as a clinical test procedure; however, it still has its diagnostic value. In our clinic we are currently concerned with a research program designed to determine the nature of the induced nystagmus resulting from applying so-called "precessional accelerations". In this the body is rotated in the supine position and any superimposed head movement (*e.g.* rotating the head on the occiput) induces a marked nystagmus the characteristics of which, when recorded by sensitive electronic recorders, provide a study of the slow components of the eye movements. Details of these findings will be presented at another time.

CONCLUSION.

In conclusion, the authors emphasize that a close association between the neurologist and the otologist often constitutes a valuable relationship in attempts to differentiate between central and peripheral vestibular disorders. Although the otologist often hesitates to pin-point an intracranial lesion on the basis of vestibular findings alone, he often may render valuable aid in this regard and sometimes furnishes the only concrete findings. With further research it is hoped that new aids will be forthcoming which will enable still more specificity in this task.

REFERENCES.

1. Carmichael, Dix and Hallpike: Disturbances of Caloric and Optokinetic Nystagmus Associated with Localized Lesions of the Cerebral Hemispheres. *Jour. Laryngol. and Otol.*, April, 1955.

2. Windle, W. F.; Groat, R. A., and Fox, C. A.: Experimental Structural Alterations in the Brain During and After Concussion. *Surg., Gyn. and Obst.*, Vol. 79, Dec., 1944.

3. Tait, J., and McNally, W. J.: In Turner's "Diseases of the Nose, Throat and Ear." 4th Ed. Bristol, p. 294.

4. Hallpike, C. S.: The Caloric Tests. *Jour. Laryngol. and Otol.*, Jan., 1956.

5. Sullivan, J. A.; Johnson, W. H., and Smith, J. K. B.: *Jour. Laryngol. and Otol.*, March, 1956.

6. Fisher, Jos. J.: "The Labyrinth," Grune & Stratton, New York, 1956.

7. Azzi, A., et al.: Does Vestibular Recruitment Exist? *Acta Oto-Laryngol.*, Stockh., 43:352, 1953.

8. Bruner, H. G.: The Significance of Bilateral Calorization in Diagnoses of Brain Tumor. *Acta. Oto-Laryngol.*, Dec., 1952.

9. Fischer, J., and Wodak, E.: Korperreflexe and Fallreaktion. *Arch. Ges. Physiol.*, 202:523, 1924.

10. Van Egmond, A. A. J.: Is Ewald's Law Valid in Man? *Jour. Laryngol., and Otol.*, 63:299, 1949.

SEVENTH INTERNATIONAL CANCER CONGRESS—LONDON, ENGLAND.

The Seventh International Cancer Congress will be held in London, England, July 6-12, 1958, under the Presidency of Sir Stanford Cade. Congress headquarters will be The Royal Festival Hall. This Congress is sponsored by the International Union Against Cancer.

There will be two main sessions of the Congress: A. Experimental; B. Clinical and Cancer Control. Special emphasis will be placed on hormones and cancer, chemotherapy, carcinogenesis and cancer of the lung.

Papers will be considered only if submitted with an accompanying abstract (not over 200 words) before October, 1957, and if dealing with new and unpublished work.

The registration fee for the Congress will be £10 (ten pounds) or $30, and the latest date for registration without late fee will be January 1, 1958.

Registration forms and a preliminary program will be available early in 1957 on application to The Secretary General, Seventh International Cancer Congress, 45 Lincoln's Inn Fields, London, W. C. 2, England.

CARCINOMA OF THE EPIGLOTTIS.*

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CLAY W. WHITAKER, M.D.,
(By Invitation),
and
FARID K. KARAM, M.D.,
(By Invitation),
Cleveland, O.

Cancer of the epiglottis has, in our opinion, been a very difficult problem. The prognosis of this disease is much worse than that of carcinoma limited to the vocal cords. A review of the literature shows a wide variation in the surgical management of this condition; thus, it appears timely that we present this topic for discussion.

From our experience, we believe that the solution of this problem lies in the more general use of radical surgery, as opposed to limited procedures, such as epiglottectomy or simple laryngectomy.

As a key to the understanding of the problem of the management of carcinoma of the epiglottis we shall review the pattern of lymphatic drainage.

In contrast to the poor lymphatic drainage of the intrinsic larynx and vocal cords, the epiglottis is supplied with a rich and intricate lymphatic system.

The lymphatics from the upper part of the larynx and from the epiglottis drain by way of the supraglottic collecting trunks, three to six in number, which pierce the thyrohyoid membrane, and in turn drain into the various nodes of the internal jugular chain. The orifice in the thyrohyoid membrane, through which the supraglottic collecting trunks pass, also permits passage of the superior laryngeal blood

*Read at the meeting of the Middle Section, American Laryngological, Rhinological and Otological Society, Cleveland, O., Jan. 9, 1957.
Editor's Note: This manuscript received by The Laryngoscope Office and accepted for publication March 20, 1957.

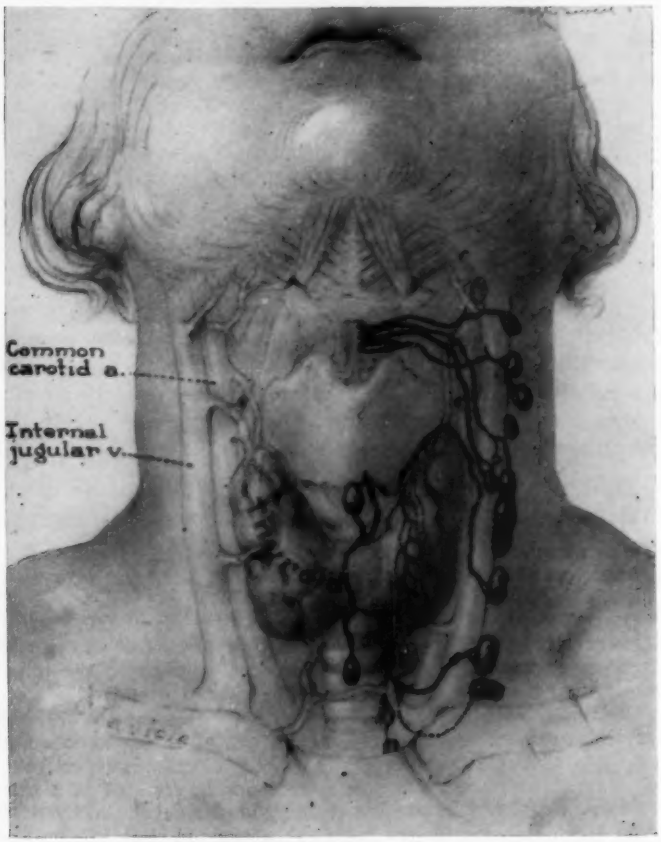

Fig. 1. Showing tymphatic drainage of larynx and epiglottis.

vessels, the lymphatics being in general anterior to the blood vessels. The collecting trunks usually unite to form three or four larger trunks. At the lateral border of the thyrohyoid muscle the collecting trunks diverge, some passing upward along the greater cornu of the hyoid bone to terminate in a

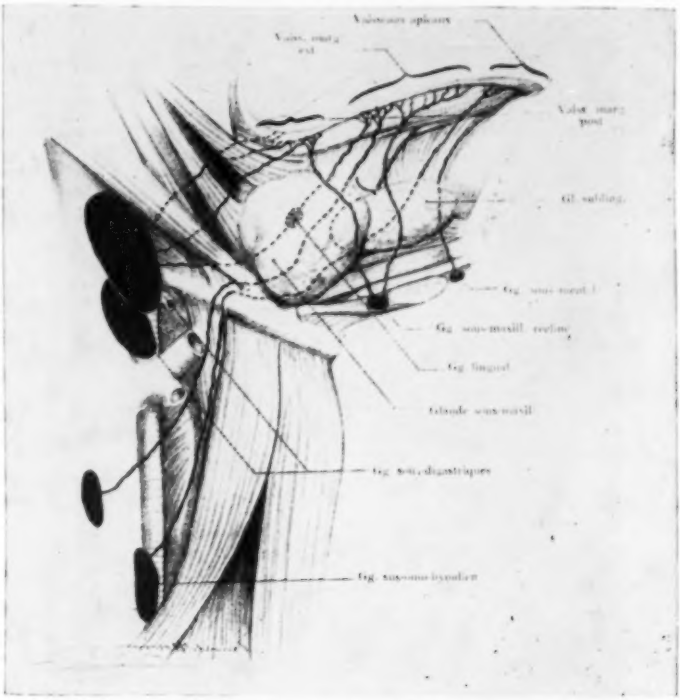

Fig. 2. Lateral view of neck showing lymphatic drainage of larynx.

subdigastric node; others pass more transversely to end in nodes in front of or lateral to the internal jugular vein.

The lymphatic drainage of the muscles and cartilages of the larynx is unknown. The drainage of the mucosa is divided into two regions, supraglottic and infraglottic. Infraglottic drainage has three main trunks, one anterior and two posteriolateral. The anterior trunk has from three to six small channels that pierce the cricothyroid membrane at various points, generally following the blood vessels. These drain into lymph nodes—pretracheal, cricothyroid, and an-

Fig. 3. Well differentiated squamous cell carcinoma occupying almost the entire laryngeal surface of the epiglottis and extending to the false vocal cords. The patient survived one year after laryngectomy and epiglottidectomy.

terior jugular—which drain ultimately to the deep internal jugular chain. The post-lateral trunks, three to six in number, pierce the tracheocricoid membrane and drain into the highest nodes of the recurrent nerve chain of the anterior deep nodes.

Rouviere[1] states that lymphatic drainage to the opposite side of the lesion is extremely rare, but possible. Reed,[2] reporting on 36 cases of cancer of the larynx found ten per cent

Fig. 4. Poorly differentiated squamous cell carcinoma with cervical node involvement. The patient had laryngectomy and left neck dissection. He survived seven months after surgery.

metastasized to the opposite side of the lesion, and six per cent metastasized to both sides.

Metastases to glands in the submental area are frequently seen, postoperatively, in patients with carcinoma of the epiglottis. When this occurs it is difficult for the laryngologist to determine whether the swelling is due to extension of the lesion or reaction to post-operative therapy. Mr. Normand Hoerr,[3] Professor of Anatomy of Western Reserve University, believes that retrograde drainage through the subdigastric

Fig. 5. Moderately well differentiated squamous cell carcinoma, base of epiglottis with extension to false cords. The patient is alive without evidence of recurrence three-and-a-half years after laryngectomy and left radical neck dissection.

and submaxillary lymph nodes may explain these metastases (see Fig. 2).

We shall illustrate with 42 cases of primary carcinoma of the epiglottis treated at St. Luke's Hospital, Cleveland, in the ten-year period 1945 to 1955. For obvious reasons the group is divided into two five-year periods, in each of which there were 21 cases. The youngest patient of either group was 31 and the oldest 73, the average age being 57. There was one female in the entire group.

Table I shows the 21 patients treated from 1945 to 1950.

TABLE I—FIRST FIVE-YEAR GROUP—1945-1950

Treatment	Number of Cases	Five-Year Survival
Laryngectomy only	13	3
Laryngectomy, later Neck Dissection	2	0
Laryngectomy with Neck Dissection	5	3
Arbuckle Procedure	1	0
Total	21	6

20 patients had post-operative X-ray.

Fig. 6. Moderately well differentiated squamous cell carcinoma of tip of epiglottis with involvement of lingual surface. There were palpable nodes on the right side of the neck. Laryngectomy and right neck dissection were followed by left neck dissection one year later. He died after 19 months.

There were 13 with simple laryngectomy and removal of the epiglottis, of which only three survived five years. Two others with laryngectomy, followed by later neck dissection, and one having an Arbuckle procedure, did not live five years. Of the five patients having combined laryngectomy and radical

Fig. 7. Moderately well differentiated squamous cell carcinoma of tip of epiglottis with cervical node involvement. This patient had laryngectomy and right neck dissection and is still alive without evidence of recurrence after eight-year follow-up.

neck dissection, three survived at least five years. In this group of patients all but one had X-ray therapy following surgery.

The use of follow-up X-ray therapy has been the general rule in our management of these cases. We feel that the poor prognosis given patients with this disease justifies this practice.

It is notable that of the 15 patients who had the simple laryngectomy, only three survived five years, although an equal number survived in the group of five having simultaneous radical neck dissection. Int is interesting also that of the

two patients who had laryngectomy and epiglottectomy, followed later by the radical neck dissection, neither survived five years.

In this group of 21 patients, ten survived at least two years. There were five more of whom the survival was unknown because of lack of follow-up observation.

TABLE II—SECOND FIVE-YEAR GROUP—1950-1955.

Treatment	No. of Cases	Present Status Living	Dead
Laryngectomy only	4	1	3
Laryngectomy, later Neck Dissection	1	0	1
Laryngectomy with Neck Dissection	15	8	7
Palliative Tracheotomy	1	0	0
Total	21	9	12

15 patients had post-operative X-ray therapy.

Table II shows the 21 patients treated for carcinoma of the epiglottis in the period 1950 to 1955.

In this group there were four patients who had total laryngectomy, but only one of whom is living after three years. The one patient who had a laryngectomy and a later radical neck dissection survived three years after the laryngectomy.

There were 15 patients who had combined total laryngectomy and unilateral radical neck dissection, and eight of these are still living. Of the eight, two were done three years ago. In none of these patients was a simultaneous bilateral neck dissection done; however, three subsequently had the other side of the neck dissected. One patient in this group was, in the opinion of the laryngologist, inoperable, and he received a palliative tracheotomy. The most significant observation to be made from this group is the marked trend from total laryngectomy to combined total laryngectomy and radical neck dissection.

Fifteen of the group received X-ray therapy, 14 being from those who had laryngectomy with radical neck dissection and one who had a subsequent neck dissection. One other patient who had the combined procedure received X-ray

treatment prior to surgery. Only two of the living patients did not have X-ray therapy.

In this second group there are four patients living two years after surgery. Ten of the group were operated on within the last two years.

TABLE III—OCCURRENCE OF SYMPTOMS OF CARCINOMA.

	No. of Cases
Hoarseness	25
Dysphagia	19
Pain referred to Ear	12
Swollen Glands in Neck	3
Hemoptysis	2
Cough	5

Table III is a listing of the symptoms these patients presented. One must remember that the hoarseness of carcinoma of the epiglottis is a thickness of the voice, rather than true hoarseness as is heard in vocal cord lesions.

TABLE IV—LOCATION OF LESIONS.

Pharyngeal Surface	3
Laryngeal Surface—Tip	2
Base	32
Mid-Line	2
Aryepiglottic Fold	9

Table IV lists the locations of the lesions. There were only three patients in whom the lesion was on the pharyngeal surface of the epiglottis. The other 39 patients had lesions arising on the laryngeal surface.

In our experience lesions of the tip of the epiglottis give few early symptoms. The two patients in our series were very far advanced when they were first seen.

Most of the lesions were located at the base of the epiglottis and were frequently associated with a lesion of the aryepiglottic fold.

Table V shows those patients who had palpable lymph nodes in the neck, and those who had positive nodes when the surgical specimen was examined pathologically.

Table VI shows the histopathological types of carcinomas encountered in our study. In the period 1945 to 1950, from

TABLE V—LYMPH NODE INVOLVEMENT.

	Number	Living
Palpable Nodes	14	4
Positive Nodes on Pathological Examination	16	4

TABLE VI—HISTOPATHOLOGICAL TYPES OF LESIONS.

Squamous cell—Well-Differentiated	11
Moderately Well-Differentiated	20
Poorly Differentiated	10
Adenocarcinoma	1
Total	42

which there were five patients who survived five years, one was well differentiated, three were moderately well differentiated, and one was poorly differentiated. Apparently the identification of the histopathological type of carcinoma is of little value in determining the prognosis.

We feel that the location of the lesion in carcinoma of the epiglottis is of more value in determining the prognosis than is the histopathological type of the carcinoma. One notable exception in our experience was the one patient who had a poorly differentiated adenocarcinoma of the left aryepiglottic fold. The patient's initial complaint was a swelling in the supraclavicular area, and despite radical surgery and X-ray therapy, this patient died five months after surgery with metastases to his brain, lungs, liver and spine.

It is evident that carcinoma of the epiglottis is a treacherous disease, and that the treatment could be considerably improved. We do not cure cancer by surgery, we remove it; so the removal must be thorough and complete. We are opposed to the simple removal of the epiglottis as a method of treatment. The rich lymphatic system affected, and the frequency with which patients have regional lymph node involvement, makes it strongly advisable to perform simultaneous radical neck dissections. This is the same opinion expressed by McCall and Fisher[4] in 1952, regarding extrinsic carcinomas of the larynx.

One difficult question is the course of action for those patients who have mid-line lesions. We believe that such lesions should be treated with total laryngectomy and uni-

lateral neck dissection, followed later by dissection of the other side of the neck. We have had poor results with bilateral neck dissection and ligation of both internal jugular veins, the patients frequently developing severe cerebral edema, sometimes leading to death. We, therefore, prefer to avoid simultaneous ligation of both internal jugular veins in patients of this age group. Facial and cerebral edema is severe. Two patients in this group had severe cerebral edema following ligation of one internal jugular vein. One patient was comatose for 72 hours, with complete paralysis of the opposite arm and leg. This patient survived nine years after surgery.

In the technique of neck dissection, if the internal jugular vein is ligated high in the neck and early in the operation, ballooning of the vein is avoided. It also prevents venous congestion and loss of blood from dilated veins.

As we have indicated by our discussion and the illustrative figures, we have come to the conclusion that the treatment for carcinoma of the epiglottis, with or without palpable lymph nodes, should include combined laryngectomy, epiglottectomy, and radical neck dissection.

The diagnosis of carcinoma of the epiglottis can sometimes be difficult. As we have pointed out, 16 patients out of this group of 42 already had cervical node involvement when first seen at St. Luke's Hospital.

We illustrate some of the types and locations of this carcinoma by the accompanying photographs of the gross surgical specimens from five of our patients.

We thank the other members of the Department of Laryngology for permission to use their material in compiling the statistics.

REFERENCES.

1. Rouviere, H.: "Anatomie Des Lymphatiques De l'Homme." Masson et Co., 1932.

2. Reed, George F.: Neck Dissection; Its Role in Cancer of the Larynx. *Amer. Laryngol., Rhinol. and Otol. Soc.*, 1956.

3. Hoerr, Normand: Personal Communication.

4. McCall and Fisher: Carcinoma of the Larynx. The Laryngoscope, 62:5, pp. 475-485, May, 1952.

SURGICAL MANAGEMENT OF CONGENITAL ATRESIA OF THE EAR.*

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The term "congenital atresia" is used by Altmann (1949) to designate a group of unilateral or bilateral malformations of the external and middle ear, and in some instances of the inner ear. The surgical correction of congenital atresia has interested otologists and plastic surgeons for many years. The plastic surgeon's main interest was obtaining some semblance of an external ear in cases of marked deformity or absence of the auricle. Very little attention was paid to the formation of an adequate external canal or the improvement in the hearing loss. The reverse is true today. Plastic surgery for reconstruction of an external ear has not proven satisfactory in the majority of cases and has been surpassed by an auricle prothesis of plastic material.

EMBRYOLOGY.

In order to understand the problems encountered in the management of congenital atresia, it is necessary to have a clear idea of the embryologic development of the ear. Detailed descriptions can be found in articles by Fraser (1931), Richards (1933), and Altmann (1949), or in texts by Arey and Hamilton, Boyd, and Mossman.

Complete absence of the external auditory meatus is the most frequent finding in congenital atresia. In some cases it may consist of a shallow funnel-shaped blind depression. The pinna may be absent, microtic or normal. The malleus and incus may be deformed or normal. The stapes may be normal, abnormal or absent. In some instances the external meatus may be patent with a well formed tympanic mem-

*Read at the meeting of the Eastern Section, American Laryngological, Rhinological and Otological Society, Inc., Toronto, Can., Jan. 31, 1957.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 23, 1957.

brane, with the abnormality being caused by deformity or fixation of the ossicles.

Since the inner ear differs widely in its phylogenetic history and in its origin from the middle and external ear, there is a marked tendency for anomalies of the inner ear to be independent of anomalies of the middle and external ear.

The cause of congenital atresia of the ear is not known. Altmann states that congenital atresia of the ear need not necessarily and invariably be the result of genetic changes; there are good reasons for assuming that in certain instances metabolic disturbances during early pregnancy may produce the same type of malformation even in the combination with other seemingly unrelated anomalies.

The literature shows congenital atresia to be more unilateral than bilateral, with the right ear being involved in a greater number of cases. The incidence has been reported by Holmes (1949) as being once in 20,000 births; at St. Michael's Hospital, Toronto, in approximately 30,000 births in the last 10 years, eight cases have been recorded at birth. As the ear examinations done in the nursery are of a superficial nature it is logical to expect the incidence is somewhat higher than reported.

SELECTION OF CASES FOR SURGERY.

The majority of cases of unilateral congenital atresia with associated microtia seek advice primarily from a cosmetic point of view. With normal hearing in the opposite ear very little attention is focused on the hearing problem. As a general rule these patients are not considered as suitable cases for surgery, because adequate hearing is obtained from the normal ear and the risk of operating on a congenital anomaly is too great. As with any type of surgery, what is to be gained by the operation must be carefully weighed against the risk involved. Unless the hearing in the operated ear can be improved to the level of the hearing in the normal ear, which is unlikely, very little is to be gained. The risks in such an operation are damage to the facial nerve in an

anomalous course, and the possibility of creating a chronic discharging ear.

There are certain unilateral cases, however, with good indications for surgery. If there is partial development of the external canal which is very narrow and extends medially to a depth of 1 or 2 cm., recurrent infections and furunculosis are prone to develop. In two of our cases, one unilateral and one bilateral, painful recurring discharge was the main reason for seeking treatment, and in both cases relief was obtained following surgery.

Evidence of good cochlear function is necessary before attempting surgical correction. In bilateral atresia the child's ability to speak indicates the presence of some hearing. By the age of four the cochlear function can be tested with reasonable accuracy. Before proceeding with any surgery to improve the hearing, in congenital atresia, it is important to advise the parents or the patient that due to the variety of anomalies that may be found at operation a second operation may be required before there is any improvement in the hearing.

SURGICAL TECHNIQUE.

Due to the anatomical variations which are encountered in congenital atresia, from the inital incision until the completion of the operation no set procedure can be followed. As Day pointed out in radical mastoid surgery, "The operation must be made to fit the patient and not the patient to fit the operaiton." This applies even more so in surgery for congenital atresia.

To date there has been considerable controversy regarding the proper methods of improving and maintaining hearing in congenital atresia. The following are the main controversial points:

1. Should the middle ear be opened up sufficiently to allow a skin graft to be placed in contact with the head of the stapes, or should the middle ear be opened up as little as possible and the skin graft tented over the middle ear in an effort to prevent scarring around the footplate of the stapes?

2. When the ossicles are found to be normal and movable, should the incus and malleus be removed?

3. If following the removal of the deformed incus and malleus the stapes is still found to be immobile, should a fenestration be done immediately or should the cavity be allowed to heal and a second stage fenestration performed?

No one surgical procedure is suitable for all cases. In our experience the best results are obtained by removing the incus and malleus, even though they are mobile, and placing a skin graft in contact with the mobile stapes. If the stapes is fixed, the horizintal canal should be prepared for fenestration, which is done at a second operation.

To obtain a dry post-operative cavity and a patent meatus, all the raw bone and soft tissue areas must be covered with skin, either as a skin flap or a skin graft. A single piece of skin may be shaped to cover the entire cavity and the meatus, or several smaller pieces may be used. The chances of getting a primary take are better if a Thiersch graft is used rather than a full thickness graft. The skin margins of the original endaural incision are sutured to the periosteum to invert them and to obliterate any dead space under the margins. The skin graft is placed in contact with these inverted margins and held in position with paraffin mesh packs which are impregnated with neomycin ointment. This packing is left in place as long as possible, which may be for three or four weeks. Using this method we have not found it necessary to use any type of mould to prevent post-operative stenosis of the meatus.

SUMMARY.

1. The term congenital atresia designates a group of malformations of the external, middle and sometimes internal ear.

2. Unilateral cases should be operated on only for specific reasons, and the operation can usually be delayed until full co-operation can be obtained from the patient. The optimum age for surgery in bilateral cases is four years. Evidence of good cochlear function is necessary before surgical correction.

SCLEROMA.

Observations on Seven Cases in One Family for 10 Years and Another Case Which Developed Intracranial Complications After Five Years.

H. JAMES HARA, M.D.,*†

Los Angeles, Calif.

We live in a remarkable age. Dreams of yesterday become realities of today. What the future has in store for mankind no one can predict. Diseases that were once thought to be incurable are now within the possibility of permanent eradication, thanks to the introduction and achievement of modern chemotherapeutic agencies. Infectious diseases that claimed such a high toll and caused permanent disability and disfigurement are well-nigh within control; however, spectacular as has been the role played by antibiotics, there has been evidence of an increasing amount of undesirable features in the use of these drugs. Thus the miracle drugs of ten years ago have lost much of their potencies. A significant number of organisms are developing resistance to these drugs. Today we are forced to carry out much more complicated and time consuming laboratory procedures to determine in each individual case the selection of the drugs to be used. This paper fully exemplifies both advantages and limitations in the use of these drugs.

In 1946 a case of scleroma in a Mexican youth of 19 was referred to me. There were six others with this disease in this family, including the father, mother and four daughters. All had been born in the United States. They have been observed during the past 10 years. Their first observation was reported in 1947.[19] Each was in various stages of this disease. Another case of scleroma in a native born Caucasian

*Read at the meeting of the Western Section, American Laryngological, Rhinological and Otological Society, Inc., San Francisco, Calif., Jan. 19, 1957.

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Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 19, 1957.

school teacher has been under my care since 1950. A short history of her progress was presented in 1953.[20]

This last patient developed an unusual intracranial complication which has never been recorded in English literature.* The scleromatous lesion invaded the left anterior fossa. It simulated a meningioma, the surgical removal of which has given her partial relief from a unilateral exophthalmus and persistent headache. A highlight in my experience in dealing with these eight cases is recorded. Also a brief review of the literature is included. Cunning and Guerry in 1942,[5] Reyes[40] in 1946, Quevedo[39] in 1949, and Zwiefach[50] in 1955 have given a comprehensive resume. Mere duplication is avoided.

Scleroma is a chronic, benign, painless proliferating granuloma which primarily involves the nasal mucosa. Because of its hard consistency and the lesion's being in the nose, the disease was first named rhinoscleroma. Later observations revealed that disease may cause primary pharyngoscleroma or laryngoscleroma depending upon the site of the growth. At the Second International Congress of Otolaryngology, held in Madrid in 1932, the more appropriate and inclusive term of scleroma was adopted in the place of rhinoscleroma.

BACTERIOLOGY.

Klebsiella rhinoscleromatis of Frisch has long been suspected to be the causative organism. This is a gram-negative, nonmotile, rod-shaped bacillus. There is increasing evidence to support this view. Levine,[28] Levine and Hoyt[29] have shown that K. rhinoscleromatis has a definite biochemical pattern exhibited by no other gram-negative rod. This organism is found only in scleroma and never in a normal nose. A number of writers[2,8,11,15,16,17,19,20,21,22, 25,26,30,31,32,33,34,35,41,42, 45, 47, 50] have recorded an apparent cure of scleroma after using various antibiotic agents, either singly or in combinations, proving the specificity of the drug and Klebsiella to be the exciting organism. This organism is always present throughout the course of the disease. It can be cultured but has not

*Birnmeyer reported a case of a 58-year-old Czechoslovakian woman who developed scleroma and died from intracranial complications.

Birnmeyer, George: Contribution to Scleroma Therapy, Arch. fur Ohren-Nasen und Kehlkopf Heilkunde, Bd 164:470-476, 1954.

been successfully transmitted to animals. Thus Koch's third postulate has never been fulfilled. Animals are apparently immune. For human beings to acquire the disease, it required prolonged close exposure. An hypothesis of the virus origin of the disease lacks evidence.

EPIDEMIOLOGY.

The exact mode of transmission of this disease is not known. No race is immune. Because of its long course, fully developed scleroma is not observed in young children. Low economic status, poor personal hygiene and malnutrition are thought to be contributory factors.[1] The female is more susceptible. The disease does not thrive in frigid regions. It is endemic in Southwestern Russia, Poland, Hungary, Egypt, Indonesia and Central America. Quevedo[39] in Guatemala states that in his country scleroma is endemic in the Southeast, but practically unknown in the Northwestern part though the racial stock and economic status of the population are the same. In Mexico all of 355 cases reviewed by Andrado Pradillo,[1] and Villasenor,[46] originated below latitude 21° north or approximately in the Southern third of the country.

Kuilman[20] in discussing my paper stated that the Chinese appear to be relatively immune. There are more than 400,000,000 Chinese in the Far East, but he had seen only one case of scleroma among them, while there were reported a large number of scleroma cases among Indonesians during his stay in Southern Asia. No case of scleroma among the Japanese has ever been recorded.

Sporadic cases are observed in various tropical and semitropical areas. The mass movement of both military personnel and civilians following World War II gave impetus to its dissemination along the routes of trade and travel. Within the past decade, the disease has been discovered in areas which had been considered immune. Among these are Sweden,[18] Hawaii,[4] Panama,[40] Brazil,[13] Portugal,[5] India,[27] Iraq,[42] Phillipines,[44] East Africa,[24] and China.[3] In the United States the earlier cases were limited to European immigrants who settled in the Eastern States.

In 1942 Cunning and Guerry collected a total of 103 cases in the United States and Canada, including six of their own. Seventeen of these were native born. Since December, 1942, there were recorded 47 additional cases. These include 24 native born, 22 foreign born, and one whose nativity was not revealed (see Table I).

TABLE I.

CASES OF SCLEROMA REPORTED IN THE UNITED STATES SINCE DECEMBER 1942 in 25 PUBLICATIONS.

Date Reported	Authors and References	Foreign Born	Native Born	Nativity Unknown
1942 —	Dixon (10)	1		
1943 —	Kellert (25)	1		
1943 —	Dill (9)	1		
1947 —	Hara and Associates (19)		7	
1947 —	Cunning (6)		1	
1948 —	New and Associates (34)	1		
1948 —	Putney (38)	1		
1948 —	Miller, C. K. (32)	1		
1949 —	Som and Jaffin (43)	1		
1949 —	Miller, A. H. (31)	1	2	
1949 —	Kline and Brody (26)		1	
1949 —	Wexler (48)	2	4	1
1950 —	Olson (36)	2	1	
1950 —	Morwitz and Horwitz (33)	1		
1951 —	Eisenstadt (12)	1		
1952 —	Russell and Associates (41)		1	
1952 —	Tische (45)		1	
1953 —	Hoover and King (23)	1		
1955 —	Dwyer (11)		1	
1953 —	Hara (20)		2	
1953 —	Hollinger and Associates (21)	3		
1953 —	Goldstein (16)	2		
1954 —	Falbre and Associates (15)	1		
1954 —	Hollender and Scheer (22)		2	
1955 —	McKibben and Bayliss (30)		1	
1956 —	Falkingburg and McCardell (14)	1		
Total		22	24	1

CLINICAL COURSE.

1. Catarrhal Stage. There are three stages in its clinical course, though they may coexist to a degree: the first is the catarrhal stage. This is usually seen in school age. The earliest symptom observed is purulent rhinitis with malodorous discharge peculiar to this disease. A creamy exudate floods the nasal cavity. One or both of the nasal passages are

obstructed. The sense of smell is impaired although one can taste some foods. The backward flow of the nasal secretion coats the posterior pharyngeal wall. After a few months to years a distinct atrophic stage sets in with heavy offensive crustation. The disease may remain static for a number of years without progressing into the second stage, which is hyperplastic granulomatous lesion. Five of my patients in this series were in this stage of the disease when I first saw them 10 years ago.

2. Granulomatous Stage. Discrete nodular submucosal infiltration produces small tubercles on the surface. These tubercles enlarge and coalesce and form irregular nodular masses. They bleed easily. They are beefy in color and often covered with crusts. Later these nodules become pale in color and cartilage-like in consistency. These masses grow posteriorly into the nasopharynx. At times they protrude into the anterior nares. The last case reported in this series was in the granulomatous stage on her first visit.

3. Scleromatous Stage. The disease reaches its final stage when fibrous scarring develops from contraction. The changes in the connective tissue are slow to develop and are irreversible. The process runs 10 to 15 years, according to Oomen.[27] Of this first group of seven, two showed marked deformities of the soft palate and stenosis of the nasopharynx. Their condition has remained static. Progressive stenosis of the laryngo-tracheal system may cause a fatal asphyxia should the lower air passage be the site of predilection. Both Oomen and Botros,[2] and his associates, stated that the external deformity of Hebra type is rarely observed at the present.

DIAGNOSIS.

Diagnosis depends on the presence of Klebsiella rhinoscleromatis in the nasal smear, and culture in the catarrhal and atrophic stages of the disease. The complement fixation test is proving to be a practical method of diagnosis, particularly in the atrophic stage. The organisms are also abundantly present in biopsy specimens taken in the hyperplastic and cicatrizing stages. During these two latter stages, Mikulicz

cells and Russell bodies are shown in biopsy specimens. Miculicz cells are not characteristic of scleroma. They are also found in leprosy, glanders and bubonic plague. They are thought to be derived from the endothelial cells. They are the result of nonspecific reaction to the toxin of the organism. Within these Mikulicz cells are clusters of Frisch bacilli. Hyaline bodies of Russell are scattered throughout, and they are probably derived from plasma cells which have undergone hyaline degeneration. Some consider that they are an end-product of degenerated Mikulicz cells. The disease must be differentiated from suppurative rhinitis and atrophic rhinitis in the earlier stages. Lues, leprosy, and carcinoma may mislead one in the sclerosing stage. The disease runs a long and insidious course. Several years may elapse before a classical and histologic change may be observed. One should not make the diagnosis on the basis of the histologic picture alone. Indeed, the tissue changes may be minimal in the early stage even though the organism is abundantly present.

TREATMENT.

In the summer of 1946 a pharmaceutical concern furnished me with a limited supply of streptomycin for clinical investigation. There was no literature to guide me as to the optimum dosage or the frequency of medication. The bacillus rhinoscleromatis belongs to the genus Klebsiella. My associates and I felt it would be susceptible to treatment with streptomycin. Later, we learned that New and his associates at Mayo Clinic also treated a case of scleroma in September, 1946, with streptomycin with success. We began treating the son of the family in November, 1946, and the father in March, 1947. Both had deforming nasopharyngeal scars which caused bilateral nasal obstruction. Corrective surgery was performed on both to relieve their respiratory embarrassment. Then the father received .5 gm. of aerosol inhalation and .5 gm. of streptomycin intramuscularly every six hours for six days or a total of 17.5 gm. His nasal culture became negative for Frisch bacillus. We thought at this time a cure had been found. He was not seen again until in July, 1954. The nasal smear was again positive. During the Fall and Winter of 1954 he received approximately 90 gm. of

dihydrostreptomycin intramuscularly. He was seen again in August, 1955. Culture was negative for specific organisms. He was completely free from nasal symptoms, and he has never felt better.

The son received 10 gm. of streptomycin in divided doses in November, 1946. He continued to harbor the offending organism after 10 days' medication. He was again seen in March and May of 1947. In 1949 he received 30 gm. of streptomycin from another physician. He reappeared at the clinic for further check in October, 1953. His nasal culture then was positive. He received dihydrostreptomycin 1 gm. daily for a period of two months, and again during the Spring and Summer of 1954, or a total of approximately 180 gm. He was seen in August, 1954, and in July, 1955. On both occasions the nasal cultures were reported to be negative, and he was apparently cured; however, the pharyngeal scars remained the same as before the institution of the antibiotic therapy.

Two sisters received 18 gm. of streptomycin in September, 1947. They developed pulmonary tuberculosis in 1948. Both were hospitalized in Denver. One received "a full course of streptomycin and P.A.S., totaling 42 1-gm. shots over a course of three months" in 1951. The other received "daily 1-gm. streptomycin for 30 days, and pneumo-abdominally for 10 months." After their treatment in the sanitarium, their scleroma was completely eradicated. Both of these girls are now married. On repeated examinations, Frisch organisms were not recovered in nasal cultures. Thus, these four, the father, son and two daughters have attained clinical and bacteriological cure with streptomycin and dihydrostreptomycin.

To the mother was given 15.75 gm. of streptomycin in seven days in September, 1947. She received no other medication. In October, 1953, Dr. Robert J. Schwarz visited her in Denver and found her nose to be crusty and presented the clinical picture of atrophic rhinitis. The organism was recovered on culture. The two other sisters received respectively, 11.25 gm. and 18 gm. of streptomycin in September, 1947. Both were in the dormant, atrophic stage. They were seen again

in June, 1954, and their nasal cavities presented an unaltered clinical picture of crusty atrophic rhinitis, from which abundant Frisch organisms were recovered.

The experiences of these seven in one family clearly indicate that scleroma is now curable when appropriate and adequate medication is given. It also shows that the chances of cure

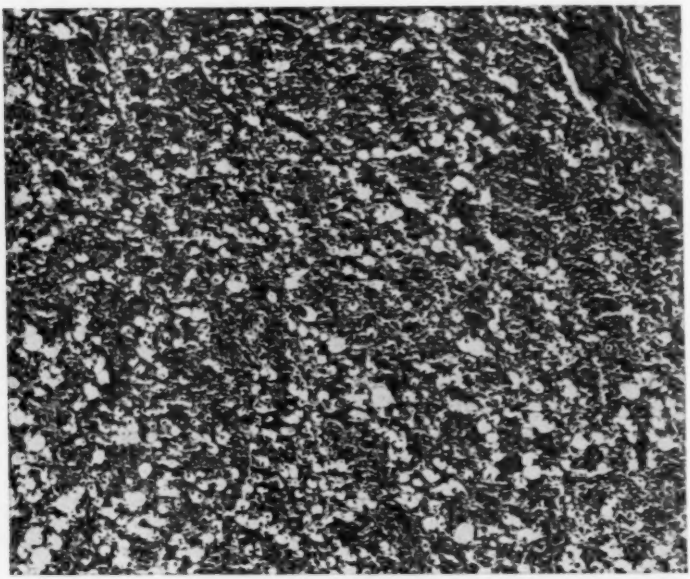

Fig. 1. There is a massive infiltration of plasma cells. Mikulicz's cells, nearly 50 microns in diameter, are conspicuous by their clear cytoplasm. They are also known as foam cells. There are a number of intensely eosinophilic hyaline cells known as Russell's or Unna's bodies.

are much better during the early stage of the disease. Scleromatous scar tissue must be handled as a separate problem, even though the organism can be eradicated from the affected stenosing areas.

Case 8 is included in this report because of apparent failure of streptomycin and subsequent development of unusual intracranial complication:

The patient is a 68-year old Caucasian retired school teacher who lived in her native state of Texas until 1939, when she moved to California. Her family history is irrelevant.

My first contact with her was on December 7, 1950, when she sought relief from her bilateral nasal obstruction which had grown progressively worse during the previous four months. Culture of her nasal secretion and biopsy specimen indicated the presence of scleroma (see Figs. 1, 2). In April, 1951, she received 1600-R radiation therapy to her anterior nares, which gave her considerable relief. This was followed by surgical excision of the obstructive nodular scleromatous mass from her left

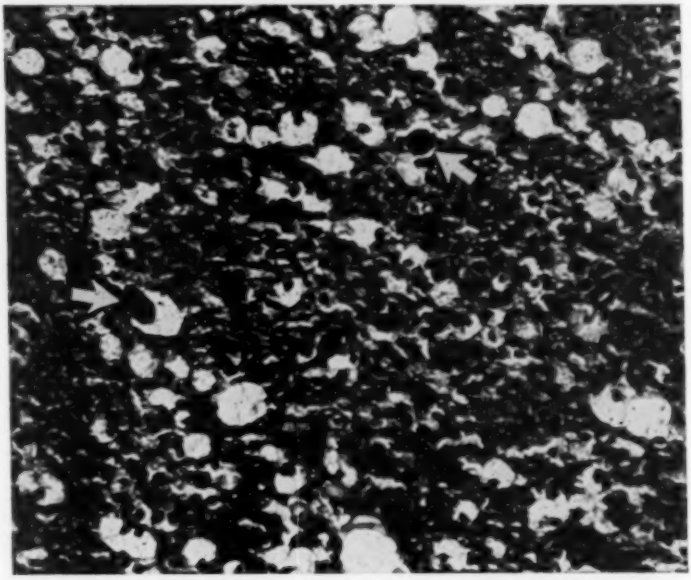

Fig. 2. Higher magnification of the same field. The arrows indicate the Unna-Russell's bodies.

nasal cavity in 1953, and from her right nostril in November, 1954. During this period she received a total of 90 gm. of streptomycin intramuscularly. July 10, 1956, she was admitted to the Los Angeles County General Hospital for diagnosis and treatment of a left exophthalmus which gradually developed during the previous three months (see Fig. 3); however, a consulting ophthalmologist found nothing of clinical importance in her orbit. X-rays of her sinuses were negative. There was a moth-eaten appearance of the left sphenoid ridge on a Roentgenogram (see Fig. 4). This was interpreted to be a possible meningioma. On August 1, 1956, an accessible major portion of the growth was surgically removed. A smaller portion was left in the middle fossa undisturbed. There was no gross break in the bony partition of the orbit. On histologic

examination of the growth by a number of competent pathologists, a diagnosis of scleroma was made.

There are several points of interest in this case: *first,* irradiation considerably relieved her nasal obstruction; *second,* antibiotic therapy, although given in an adequate quantity over a long period of time, failed to eradicate the organism. Almost everyone who has had clinical experience with the treatment of scleroma considers steptomycin to be

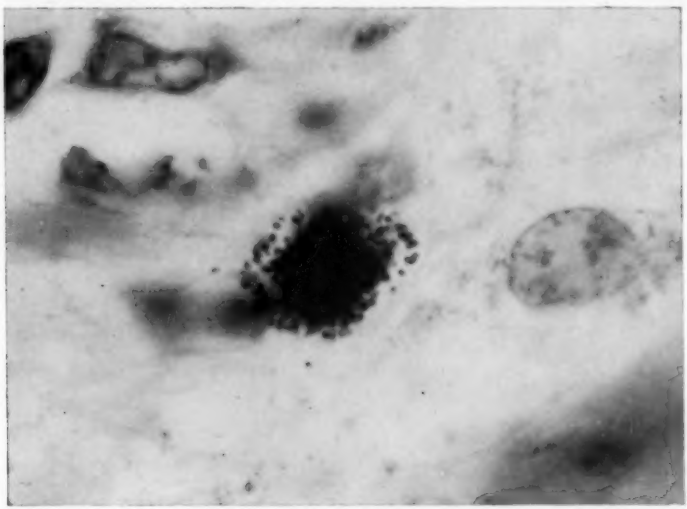

Fig. 3. Von Frisch's K. rhinoscleromatis in one of histiocytes.

the drug of choice. This enthusiasm, however, was not shared by Cunning, who used 350 gm. of the drug over a period of nine months without appreciable benefit, although the secondary invaders disappeared. There is no agreement as to the optimum daily dose nor as to the total amount of the drug to be used in each case. Some advise that P.A.S. be added to streptomycin therapy to gain a greater efficiency and to lessen the chances of developing drug resistance. Doubtless, some strains of Frisch bacillus develop drug resistance sooner than others. *Third,* repeated nasal cultures always revealed

Fig. 4. Pre-operative roentgenogram showing erosion of the left sphenoid ridge.

the presence of secondary organisms but failed to detect the presence of Frisch bacillus. *Finally*, the most remarkable feature in this instance was that the lesion extended beyond the usual confines of the respiratory tract, either through

the ethmoidal orbital plate or by way of the nasolacrymal tract into the orbit; thence the growth spread into the intracranial structure through one of the named or unnamed foramen, and established a new focus.

SUMMARY.

1. Observations on the clinical management of eight cases of scleroma extending over 10 years in seven cases and five years in one case are presented.

2. The best results are achieved when antibiotic therapy is instituted in an early stage of the disease.

3. Streptomycin is the drug of choice according to various clinicians.

4. Drug-fastness may develop and mask symptoms.

5. A rare intracranial complication is presented in one case.

REFERENCES.

1. Andrade, Pradillo J.: Scleroma in Mexico. Review of 335 Cases. Nutritional State as an Etiological Factor. *Revista de Investigacion Clinica, Mexico,* 1:505-513, Jan.-April, 1949.

2. Botros, G.; Hamilton, P. K.; Floyd, T. M.; Mufti, A., and Imam, A.: Scleroma in Egypt. *Ann. Otol., Rhinol. and Laryngol.,* 63:1031-1055, April, 1954.

3. Chu, C. S.; Hsiao, S. C., and Chu, T. T.: Rhinoscleroma; Report of a Case. *Chin. Med. Jour.,* 69:235-238, May-June, 1951.

4. Crawford, H. E., and Gerundo, M.: Rhinocleroma. *Hawaii Med. Jour.,* 7:23-28, Sept.-Oct., 1947.

5. Cunning, D. S., and Guerry, D. III: Scleroma. *Arch. Otolaryngol.,* 36:662-678, Nov., 1942.

6. Cunning, D. S.: Rhinoscleroma in Two Native-born Brothers. *Ann. Otol., Rhinol. and Laryngol.,* 56:1088-1090, Dec., 1947.

7. Curkovic, M.: Streptomycin in Treatment of Scleroma; Report of Three Cases with Successful Results. *Arch. Otolaryngol.,* 52:253-256, Aug., 1950.

8. Da Gama, M. M.: Rhinoscleroma; Bacteriological Study of a Case. *Clinica Contemporanea,* 2:15, 863-870, 1947.

9. Dill, J. L.: Rhinoscleroma; Report of a Case. *Ann. Otol., Rhinol. and Laryngol.,* 52:496-500, June, 1943.

10. Dixon, F. W.: Scleroma. *Arch. Otolaryngol.,* 36:937-939, Dec., 1942

11. Dwyer, G. K.: Laryngoscleroma; Report of a Case. *Ann. Otol., Rhinol. and Laryngol.,* 62:191-193, Jan., 1953.

12. Eisenstodt, L. W.: Scleroma of the Nose and Lip. *Arch. Otolargngol.*, 53:446-450, April, 1951.

13. Falcao, P. C.: Rhinoscleroma in Brazil; Report of a Case. *Arch. Otolaryngol.*, 45:476, April, 1947.

14. Falkingburg, L. W., and MacCardell: Scleroma. *Arch. Otolaryngol.*, 64:190-195, Sept., 1956.

15. Folbre, T. W., Manhoff, Jr., L., and Frazier, D. W.: Rhinoscleroma Successfully Treated with Oxytetracycline (Terramycin). *Arch. Otolaryngol.*, 60:505-507, April, 1954.

16. Goldstein, H. Z., and Kasoff, H. E.: Scleroma; Report of Two Cases with Review of the Literature. *Jour. Newark Beth Israel Hosp.*, 4:174-181, July, 1953.

17. El-Hakeen, A.; El-Samma, Ezz., and Mossaliam, I.: Aureomycin Therapy in Laryngoscleroma. A Report on Five Cases. *Jour. Laryngol.*, 68:523-534, Aug., 1954.

18. Handstedt, S.: Scleroma in Nose and Larynx Following a Case. *Acta-Oto-Larygol.*, 34:339-349, April, 1946.

19. Hara, H. J.; Pratt, O. B.; Levine, M. G., and Hoyt, R. E.: Scleroma; a Clinico-Pathological Study of Seven Cases in One Family. *Ann. Otol., Rhinol. and Laryngol.*, 56:769-783, Sept., 1947.

20. Hara, H. J.: Present Status of Scleroma in the United States. *Proc. Fifth Internat. Cong. Oto-Rhino-Laryngol.*, Amsterdam, 297-303, May, 1953.

21. Holinger, P. H.; McMahon, R. J., and Johnston, K. C.: Rhinoscleroma. *Ill. Med. Jour.*, 103:341-343, June, 1953.

22. Hollender, A. R., and Scheer, H. M.: Curability of Scleroma. *Jour. Int. Coll. Surg.*, 21:24-29, July, 1954.

23. Hoover, W. B., and King, G. D.: Rhinoscleroma. *Arch. Otolaryngol.*, 57:79-82, Jan., 1953.

24. Kafero, E. D.: A Case of Rhinoscleroma. *East. Afr. Med. Jour.*, 28:315-317, Aug., 1951.

25. Kellert, E.: Rhinoscleroma; Report of Case. *New Eng. Jour. Med.*, 229:647-650, Oct. 21, 1943.

26. Kline, P. R., and Brody, E. R.: Scleroma. *Arch. Dermatol. and Syphilol.*, 59:606-619, June, 1949.

27. Lahiri, K .D.: Rhinoscleroma. *Jour. Indian Med. Assn.*, 18:114, April, 1949.

28. Levine, M. G.: Scleroma; Further Studies on the Etiologic Agent. *Amer. Jour. Clin. Path.*, 21:546-549, June, 1951.

29. Levine, M. G., and Hoyt, R. E.: Diagnosis of Scleroma. *Arch. Otolaryngol.*, 47:438-445, April, 1948.

30. McKibben, B. G., and Bayliss, M. W.: Scleroma in the United States. Report of a Case in a Native. *U. S. Armed Forces Med. Jour.*, 6:1515-1524, Oct., 1955.

31. Miller, A. H.: Scleroma of the Larynx, Trachea and Bronchi. The Laryngoscope, 59:506-514, May, 1949.

32. Miller, C. K.: Scleroma. *Northwest Med.*, 47:504-505, July, 1948.

33. Morwitz, S. M., and Horwitz, I. D.: Rhinoscleroma; Report of a Case Treated with Dihydrostreptomycin. *Ann. Otol., Rhinol. and Laryngol.*, 59:569-571, June, 1950.

34. New, G. B.; Weed, L. A.; Nichols, D. R., and Devine, K. D.: Rhinoscleroma Apparently Cured with Streptomycin. *Ann. Otol., Rhinol. and Laryngol.*, 57:412-417, June, 1948.

35. New, G. B.: Rhinoscleroma Apparently Cured with Streptomycin. *Arch. Otolaryngol.*, 49:119-120, Jan., 1949.

36. Olson, G. W.: Scleroma; Resume of the Literature; Report of Three Cases. *Ann. Otol., Rhinol. and Laryngol.*, 59:186-196, Jan., 1950.

37. Oomen, H. A. P. C.: The Clinical Course of Rhinoscleroma. *Docum. Med. Geograph. et Trop.*, 4:124-133, June, 1952.

38. Putney, F. J.: Rhinoscleroma. *Arch. Otolaryngol.*, 47:816-817, June, 1948.

39. Quevedo, J.: Scleroma in Guatemala, with a Study of the Disease Based on the Experience of 108 Cases. *Ann. Otol., Rhinol. and Laryngol.*, 58:613-645, Sept., 1949.

40. Reyes, E.: Rhinoscleroma. Observations Based on Study of Two Hundred Cases. *Arch. Dermat. and Syph.*, 54:531-537, Nov., 1946.

41. Russell, D. A.; Moore, J. M., and Mattman, L. H.: Rhinoscleroma Successfully Treated with Streptomycin. *Jour. Amer. Med. Assn.*, 148:642-643, Feb. 23, 1952.

42. Saeed, Y. M.: Record of Three Cases of Rhinoscleroma in Iraq. *Jour. Laryngol. and Otol.*, 64:353-356, June, 1950.

43. Som, M. L., and Jaffin, A. E.: Specific Treatment of Rhinoscleroma with Streptomycin. *Jour. Mt. Sinai Hosp., N. Y.*, 15:326-329, Jan., 1949.

44. Tan, M. G., and Simuangco, S. A.: Scleroma (rhinoscleroma); First Case Report in the Philippines. *Jour. Philipp. Med. Assn.*, 27:163-169, March, 1951.

45. Titche, L. L.: Scleroma; Report of a Cast Apparently Cured by Streptomycin. *Ann. Otol., Rhinol. and Laryngol.*, 61:400-407, Feb., 1952.

46. Viliasenor, C., and Andrade, Pradillo, J.: Rhinoscleroma and Antibiotics. *Rev. Med. Hosp. Gen.*, 15:323-334, June, 1952.

47. Waeser, H., and Schmidtmann, M.: Treatment of Rhinoscleroma with Terramycin. *Jour. Laryngol., Rhinol. and Otol.*, 31:295-299, June, 1952.

48. Wexler, M. R.: Scleroma Simulating Atrophic Rhinitis; Clinical Differentiation and Laboratory Confirmation. The Laryngoscope, 59:1026-1029, Sept., 1949.

49. Zerne, G. E.: Scleroma in Panama; Report of Two Cases. *Arch. Otolaryngol.*, 57:452-453, April, 1953.

50. Zwiefach, E.: Rhinoscleroma. *Jour. Laryngol.*, 69:321-330, May, 1955.

POST IRRADIATION DAMAGE TO THE PHARYNX, LARYNX AND ESOPHAGUS.*

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The immediate effects of too much Roentgen irradiation on the skin, subcutaneous tissue and cartilage are well-known. Stewart and Sammon[1] summarized the histopathology as a fracturing of the blood vessel wall, followed by thrombosis, with a slowing or cessation of circulation, depending upon the damage and size of the vessel.

Reports of late damage to the deep tissues of the pharynx, larynx and upper esophagus are not common. Two patients have come under my care, suffering damage from prolonged irradiation therapy for non-cancerous lesions ten to 15 years ago. One of them developed a carcinoma in the irradiated area.

Case 1. D.M.F., a 46-year-old white female was first seen Jan. 12, 1955, complaining of severe dyspnea and dysphagia. She stated that, 15 years ago she had 25 to 30 X-ray treatments to both sides of her neck over a period of several months. Treatments were given for tonsillitis in an unlicensed doctor's office. Nine years ago, she had had a tonsillectomy. Following this procedure, she noticed some difficulty in breathing, talking and swallowing. Five years ago, an otolaryngologist told her that one vocal cord was paralyzed. During the last three months her complaints became severe, and she remained home from work.

The patient was admitted to the hospital as an emergency case. She was short of breath, could not swallow solids, and fluids caused fits of coughing. The skin of her neck was thin and pale, with scattered areas of telangiectasis, and the muscles of the neck were somewhat atrophied. There was no movement of the left vocal cord and very little of the right. Pools of fluid rested in the pyriform fossae. Other than that the patient weighed 78 pounds, the general examination was uninteresting.

A tracheotomy was performed, followed five days later by a direct examination. The left vocal cord was fixed in the midline, and the arytenoid was partly adherent to the pharyngeal wall. There was limited right cord movement. A 5 mm. bronchoscope passed through the cords showed a normal trachea. A small esophageal lumen was dilated with

*Read at the meeting of the Eastern Section, American Laryngological, Rhinological and Otological Society, Inc., Toronto, Canada, Jan. 31, 1957.

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Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 23, 1957.

bougies until a 7 mm. esophagoscope could be passed. The stenosed area was about three-fourths of an inch in length, followed by a normal esophagus. A biopsy taken from this area was reported granulation tissue.

During the next month, the patient was dilated a number of times, first directly and then over a string. Feedings were through a duodenal tube. She was allowed to go home with a No. 26 French mercury bougie to swallow daily.

On March 21, 1955, she was re-admitted for further examination and dilatation, and was discharged with a No. 32 French mercury bougie to swallow daily. Further admissions in May, 1955, and March, 1956, for examination and dilatation were carried out. Improvement in the esophageal lumen was noted, but the laryngeal picture, if anything, had deteriorated.

At one time, considerable thought was given to closing the larynx, or a laryngectomy; however, as the dilatation of the esophagus proceeded, solids were easily handled and fluids became less troublesome. The patient put on 40 pounds weight and went back to work after her second hospital admission. She is content to leave things as they are, at least for the time being. In addition, two or three attacks of perichondritis around the tracheotomy tube showed evidence of a poor blood supply and the danger of further operative work.

Case 2. E.H., a 41-year-old white female was first seen in September, 1952, with the complaint of a hoarse voice and fullness in her throat for a few weeks. This patient had a series of at least 25 to 30 X-ray treatments to her neck over a period of a year, 11 years ago, for tonsillitis. The skin of her neck was thin and pale, and spotted with areas of telangiectasis. The neck muscles were atrophied. The general history was not remarkable, other than her vision, which was badly impaired by bilateral cataracts.

A benign polypoid fibromata, about three-fourth of an inch in diameter, was removed from her right aryepiglottic fold. Three months later, a remaining remnant was removed and the base electro-coagulated. Sections of this remnant showed one area suggestive of early malignant change.

The patient was followed for over a year without any sign of growth return. Further appointments were not kept, and the patient was not seen for two years until October, 1955.

At that time, there was an extensive growth involving the right aryepiglottic fold, pyriform fossa, and pharyngeal wall up to the base of the tongue. Biopsy of the material showed it to be a carcinoma. On Oct. 26, 1955, a laryngectomy, partial pharyngectomy, and block dissection of the glands of the right side of the neck was performed. Only enough pharynx was left at the base of the tongue to sew around a duodenal tube.

Post-operatively, the tissues of the neck became hard and board-like. The patient was unable to swallow fluids around the tube. We were able to dilate the pharynx up to No. 40 French dilator and, on two occasions, indwelling tubes about size No. 36 were left in the area for a few days. An hour or so after their removal, the patient was unable to swallow water. This rapid collapse was apparently due to pressure of the rigid neck tissues. An area of necrosis developed in the trachea lying against the convexity of the tracheotomy tube. This developed into a tracheo-esophageal fistula about a half-inch in diameter.

On March 18, 1956, a gastrostomy was performed and a feeding tube

inserted. The patient was discharged three weeks later to attend our out-patient department.

This was 10 months ago. She resumed her former work of managing a rooming-house. Her general health has improved. The fistula has narrowed to a fissure, and the tissues of her neck have softened a great deal.

It would seem that further time might be allowed to see whether the fistula will close. Mobilized skin flaps or other means may be necessary to achieve this. In the meantime the neck tissues are becoming more mobile, and it is possible that the time may be coming when it will be easier to maintain a useful pharyngeal lumen. A feeding tube has been left in place. The danger of further irritation from it seemed less than the risk of losing a lumen for the salivary secretions.

Two cases showing post-irradiation damage to the pharynx, larynx and esophagus have been presented. Both patients had rather spare, small bodies. The skin over the neck was thin and pale and exhibited telangiectatic areas. The muscles of the neck were atrophied.

In Case 1, a fibrosing lesion almost completely blocked the post-cricoid area and immobilized the vocal cords. In Case 2, a benign and then a malignant lesion appeared in the area of irradiation. The irradiation not only has been a major factor in the post operative complications but, also almost certainly has been the cause of her loss of vision, due to bilateral cataracts.

Cancer following extensive therapeutic irradiation, while relatively common in the skin, rarely occurs in the deep tissues. Most of the irradiation tumors in the deep tissues are bone sarcomata. Hatcher,[2] in 1945, reported three cases and reviewed the literature of a total of 24 cases. Goolden[3] reported four cases in the region of the neck and added six other cases from the literature. Holinger[4,5] added three further cases, and since then has added a fourth. These authors believe that, when a cancer occurs several years following prolonged X-ray therapy for a non-cancerous lesion in the site of irradiation, it may be termed an irradiation cancer.

Two or more decades ago, X-ray therapy for glands in the neck, toxic thyroiditis and other conditions was popular in some centers. There will always be enthusiastic quacks with X-ray machines. It may be that more of their cases will appear over the next few years.

REFERENCES.

1. Stewart, J. P., and Sammon, J. D.: The Treatment of Severe Progressive Epistaxis by Radiotherapy. *Jour. Laryngol.*, 70:82-91, 1954.

2. Hatcher, C. H.: Development of Sarcoma in Bone Subjected to Roentgen or Radium Irradiation. *Jour. Bone, Joint Surg.*, 27:179-195, 1945.

3. Goolden, R. W.: Radiation Cancer of the Pharynx. *Brit. Med. Jour.*, 2:1110-1112, Nov., 1951.

4. Holinger, Paul H., and Rabbett, Wm. F.: Later Development of Laryngeal and Pharyngeal Carcinoma in Previously Irradiated Areas. The Laryngoscope, 105-112, Feb., 1953.

5. Holinger, Paul H.: *Chicago Laryngol. and Otol. Soc.*, Jan., 1956.

SOUTH CAROLINA SOCIETY OF O. & O.-L., AND NORTH CAROLINA E. E. N. & T. SOCIETY JOINT MEETING.

The joint annual meeting of the South Carolina Society of Ophthalmology and Otolaryngology and the North Carolina Eye, Ear, Nose, and Throat Society will be held in Hendersonville, N. C. The dates are September 15, 16, 17, 18, 1957. Headquarters will be the Skyland Hotel. The following guests ophthalmologists will be on the program:

Dr. E. A. Naumenee of Baltimore, Md.; Dr. P. G. Leinfelder of Iowa City, Iowa; and Dr. Alston Callahan of Birmingham, Ala. Likewise the following otolaryngologists will be on the program:

Dr. Francis LeJeune of New Orleans, La., and Dr. J. W. McLaurin of Baton Rouge, La. The third otolaryngologist will be announced shortly.

Hendersonville, N. C., is located in the Blue Ridge Mountains, and is a particularly lovely spot at this season of the year. A large attendance is anticipated. For further information write Dr. Roderick MacDonald, Secy.-Treas., 330 East Main St., Rock Hill, S. C.

STEROIDS AND INFLAMMATION IN OTOLARYNGOLOGY.*†‡

DAVID A. DOLOWITZ, M.D.,
and
THOMAS F. DOUGHERTY, Ph.D.,
Salt Lake City, Utah.

With the advent of antihistamines and steroids, there has been a revolution, not only in the treatment of nose and throat problems, but also of the basic underlying theory. An effort is being made to present a concept prevalent at the University of Utah, developed under the leadership of Dr. Thomas Dougherty. Because of the time element, no effort is being made to give credit to the many men whose contributions have been worked into this concept, nor to try to establish its validity. It is presented as a working theory, which will permit us to understand the problems, and perhaps treat them more easily.

It is felt that inflammation is a non-specific reaction of an organism to injury. The course of events starts with injury to a cell. The injury may be mechanical, thermal, viral, bacterial, etc. When the cell is damaged, histamine or other basic amines are elaborated from the cell and work their way out into the ground substance. This increased "histamine" is tonic to the neighboring cells. Depending upon the threshold of resistance of the cell, a chain reaction is set up. If there is an inadequate capacity of the body to de-toxify and destroy histamine, the chain reaction will continue destroying the cells. When this process reaches recognizable forms, what we call inflammation ensues. Hence,

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*Read at the meeting of the Western Section American Laryngological, Rhinological and Otological Society, Inc., San Francisco, Calif, Jan. 19, 1957.

†From the Department of Surgery and Anatomy University of Utah Medical School, the Memorial Medical Center and the Holy Cross Hospital, Salt Lake City, Utah.

‡Material used in the study was supplied by Schering, and the theoretical work supported by Grant No. DA-49-007-MD-130, Department of the Army.

Editor's Note: This manuscript received in The Laryngoscope Office and accepted for publication April 23, 1957.

the extent of damage is determined by the cellular thresholds, so that we may have injury to one cell, with no further damage, or in an adrenalectomized animal, where the ability to stop the chain reaction is nil, the cells will continue destroying themselves until death results from shock. It is felt that allergy, anaphylaxis, inflammation, general body stress, are all manifestations of the same process, but varying in degree.

An analysis of the pathology shows that it consists of an exogenous damage, followed by a secondary endogenous effect. It is interesting to note that medical specialization has developed along anatomic lines. Because of this, treatment is usually anatomic, and has been limited until the present era, to treatment of the exogenous factors. It has been puzzling at times, that a mild exogenous trauma can cause severe endogenous damage, as for example, death from a bee sting. Because of this, we have frequently been unclear in our thinking. We confuse infection with inflammation; we confuse bacterial invasion or infection, with inflammation; and, as we treat the infection, we feel that we are treating the inflammation.

Winternitz has often said that the anatomy differs, but the pathology remains the same. This becomes obvious as we consider that the effect of endogenous damage is the same in no matter what organ, the differences being caused by the different anatomy.

Since we are all familiar with the exogenous treatments, we will concentrate more on the endogenous. We have seen that inflammation is a chain reaction of cellular discharge, each cell affecting the next one by toxins released from the damaged cell. There are three factors that tend to control this. The first, the steroids, chiefly hydrocortone, toughen the cell membrane so as to render it less permeable to histamine penetration. This decreased permeability will last much longer than the hydrocortone itself, which has caused the effect. An experiment to illustrate this will be presented later.

Second, there is local inhibition of the toxins. This is ac-

complished in several ways: first, histamine is acted upon by antihistamine or histaminase; second, the Mast cell granules released at sites of injury pick up histamine and transport it back into the fibroblasts, where it is released in response to physiological demands; third, heparin and other acid polysaccharides combine with the basic amines to form a neutral substance which is not toxic and disappears without causing damage. Stilbamamide, neomycin and polymixin were given until lethal 50 for mice was established. If given with heparin in adequate amounts, complete protection may be obtained. A discussion of the application of this finding in a clinical case will soon be presented.

Third, there is a removal as by excretion, of the toxin. Bram Rose has shown that there is a markedly increased histamine in the urine of asthmatics during their attacks. He has taken 11 cases of pure asthma, reacting to rag-weed to the extent of asthma. All 11 showed increased histamine in the urine. He then, in the rag-weed season, protected these patients by injections of ACTH, then exposed them to the pollens. No asthma resulted, but in every case, there was a marked increased histamine in the urine. This shows that the original cell damage by the pollen, was present; but that the toughening of the adjacent sister cells by the steroid was sufficient to protect it against further extension of the process.

A case showing the second tvpe of protection is illustrated by T.W. 4930-54, Holy Cross Hospital.

A six-year-old boy was admitted with a story of high fever, 104.8, vomiting and headache. He had complained of cough for the past week, fever for the past four days. He had been hospitalized elsewhere. His chest plate was clear. Despite adequate doses of Terramycin, there was no improvement. He was transferred to us; on admission, he had no pain, but a slight headache in the left side of the head. He was lethargic, dehydrated, with a slightly stiff neck, suggestive of meningitis. There was slight periorbital edema, confined to the evelids; the sclera being only minimally injected. A spinal tap showed 229 cells, 62 per cent of which were lymphocytes, the remainder polys. A diagnosis of ethmoiditis and sphenoiditis was confirmed by X-ray. The increasing periorbital edema was felt to be due to an orbital abscess, as most of the edema was on the right side. By the following morning, chemosis of the right eye had developed, and both eyes were proptosed. A tentative diagnosis of cavernous sinus thrombosis was made and confirmed by two pediatricians and a neurosurgeon.

It was felt that there were two main problems—the infection and

the thrombosis. To combat the infection, intra-nasal ethmoidectomy and sphenoidectomy were performed, and patient was started on shot-gun therapy consisting of achromycin, chloromycetin and erythromycin. To combat the thrombosis, the wound was left open, a tracheotomy was performed, allowing the removal of any blood that drained down into the lungs. It was decided to heparinize the patient, to combat the thrombosis, and at the same time, de-toxify the released histamine.

Culture showed a hemolytic staph. albus, sensitive to erythromycin and chloromycetin, so the achromycin was discontinued. He was continued on a mixture of heparin and depo-heparin, protamine being used to neutralize the heparin whenever the bleeding would become excessive. As the hemocrit became low, the blood was replaced by transfusion.

After a rather stormy course, the patient recovered uneventfully. While it is impossible to place the credit in any one factor, it was felt that the heparin, by neutralizing the histamine, helped the antibiotic tremendously in limiting the infection. Daily cultures were taken, and by the fifth day, the staphylococci disappeared, not to re-occur in the subsequent cultures, repeated for 22 days. Incidentally, the patient has been well ever since.

Thus we see, that regardless of the site affected, inflammation or allergy is a reaction of the interstitial connective tissue; the degree of inflammation depends on the nature and the amount of the irritating substance. Allergy is definitely a type of inflammation. It is interesting to note that the more alkaline the area, the more histamine is liberated. The resulting edema may cause anoxia, which will further increase the pH, and when we reach the point of nine, we have complete destruction, which if widespread enough, results in death. This is the anaphylactoid type of reaction, where contact of the antigen and the blood causes the reaction in all parts of the body simultaneously. Since histamine is more stable than the enzyme, which would destroy it (for example, histaminase or triaminase, etc.), once the reaction passes a certain point, unless we can control it with our new drugs, the results are fatal. This, whether we have anaphylaxis or shock, bolstering our contention that these are all varying views of the same process.

Corticosteroids all have the same anti-inflammatory action. This is effected by limiting the chain reaction; the mechanism works by making the cells less destructible. (Our postulation is that this is accomplished by decreasing the permeability of the cell membranes.)

In an effort to see how this works, radio-active C-14, labeled "Hydrocortisone," which is now called Cortesole, is injected

into a given tissue. Section and studies show that the cortesole is selectively picked up by fibroblasts. At various times after this has been given, a mild inflammatory agent, (as histamine, egg albumin, or one per cent gelatin), is injected into the same area. Sections are prepared at different intervals. Examination shows a terrific fibroblastic destruction, with survival of rounded epithelial-like fibroblasts. The photographic films show that these are the cells containing the cortesole. The optimum time for protection of the cells is not known. By timing the sections we find that the hormone disappears from the fibroblasts in an inflammatory area in approximately 45 minutes; however, it must be noted, that though the hormone acts on the cell, and is metabolized, its protection of the cell will persist. The optimum time is being studied and the time effect of the hormone on the cell is still not known.

It is to be stressed, that this is not a pharmacologic type of therapy, but is rather a replacement therapy similar to insulin in the diabetic. There are many oxysteroids, and their potency varies in nature. For our purposes, I think it is sufficient to say that hydrocortone is the strongest anti-inflammatory substance found in the human. The action of the synthetic prednisone and prednisolone, is much stronger, not because its action is stronger, but because the liver destroys it much more slowly than the natural hormones. We are in the process of studying whether its local injection has any different strength of action than hydrocortone.

About six years ago, it was felt that sufficient data had been accumulated for an effort to be made to utilize steroids clinically. Because of its scarcity and obvious ease of admission, local therapy was first tried in the form of nose drops. In our hands it proved unsuccessful, only about 20 per cent of the cases having temporary improvement; and this type of case would give the same improvement when sterile water was used.

It was then determined to start the next step of trying it both locally, by injection, and systemically. The nasal work will first be discussed. It was felt that there were four types of nasal obstruction: infectious, allergic, vasomotor and hor-

monal. With antibiotics, the acute infections were subsiding so well that it was thought inadvisable to attempt this group; therefore, the sub-acute and chronic sinusitis and rhinitis cases were first selected. Material was taken for culture and sensitivity studies, and the patient put on the appropriate antibiotic. If the sinus did not clear, ten milligrams of Cortisone were injected into the turbinates in the region of the orifice of the affected sinus. This improved our results in about 80 per cent of the cases affected.

Cases of allergic rhinitis were treated first with antihistamines, and again, in the few failures, Cortisone was injected similarly, and again we had a tremendous rate of improvement.

In many cases, the division was not clear cut, as it was quite obvious that an allergic case, by obstruction, would soon become infected.

Hormonally, the commonest problem was the swelling of the nose, so frequently accompanying pregnancy. Working with the Department of Obstetrics, under supervision of Dr. Emil Holmstron, we tried giving Cortisone, first locally by injection into the turbinates of these women. A great majority of them would improve tremendously. Usually, unless contraindicated, we would use some penicillin as a protective agent.

CASE REPORTS.

Mrs. K. C., age 38: Troubled with sinusitis for many years, relieved by bilateral antral windows, then free of symptoms for three years, until the third month of pregnancy. For the next three months, had increasing nasal obstruction, until she had difficulty in sleeping. She developed a post nasal drip and cough, which was a great worry to the obstetrician. Examination showed greatly hypertrophied turbinates, with swollen edematous mucous membrane; open antral windows; profuse watery mucoid exudate, coming from the turbinates and sinuses. Chlortrimeton brought relief for about a week, then there was a return of the symptoms. At five day intervals, Cortone was injected into the turbinates with moderate improvement of the airway. Despite the local improvement she developed asthmatic symptoms, and was referred to an allergist, who was able to control both the asthma and nose on low doses of Cortisone.

Mrs. E. H., age 33: Was six months pregnant, had had upper respiratory infection for two weeks, sinusitis for ten days, pain in the ears for four hours. She was put on combiotic and Teldrin. Culture taken. Pain disappeared from the ear in 24 hours, but fluid remained. Sensitivities suggested switching to Dihydrostreptomycin. This, plus Teldrin, cleared

the infection but not the swelling or fluid in the sinuses or ear. She was reluctant to have paracentesis, so was put on Cortone, 25 mm. four times a day, with Dihydrostreptomycin, one-half gram. All symptoms cleared in four days and were kept under control with Teldrin throughout the remainder of the pregnancy.

In the final group, of the vasomotor rhinitis, we believe there must be some other factor involved, besides inflammation, because this is the only group in which the injection of Cortisone would only help in about a third of the cases. A much better result could be obtained if a sclerosing solution was injected into the turbinate, than if Cortisone was used. It is our feeling that the hypertrophy of the turbinate is probably due to some mechanism of the neural junction, rather than the inflammatory swelling.

The systemic steroids became more available. Prednisone and Prednisolone could be given without the dangers of fluid retention, which had proved somewhat of a handicap in our hands in the early stages of using Cortisone systemically. We then began to substitute oral administration for local injection, as this is much more pleasant for the patient. When adequate dosages are given, the results are not only equal, but also are superior to that of injection.

When using steroids systemically several dangers must be considered: first, there is some question as to whether or not infection may spread more rapidly in the presence of Cortisone. Until this question is decided, one must be extremely cautious. We find that in the sinuses, unlike the soft tissues, Cortisone may be used with more safety; however, in our hands, we always culture the infection and obtain the appropriate antibiotic as a protective mechanism before using the steroid, even when the predominant difficulty is allergic.

Second, if the steroid has been given for any length of time and surgery is required, one must be extremely careful to have an adequate blood level, as we have seen several cases, where an Addisonian type of reaction developed on the operating table. Blood pressure would fall, and most of the usual drugs were not able to restore it. The best result has been obtained by levophed.

There has been much debate whether, after a two-week, or one month interval, one has safety. At first, our feeling was that after a two-week lay-off of steroids, one could safely operate; however, later work has shown an occasional case that has caused trouble for as long as six months. The Mayo Clinic claims that they have had trouble after a year's lay-off; therefore one must get an adequte blood level.

We have been playing with the idea, that ACTH given during the period of steroid treatment tends to protect the adrenals; however, we have found that some patients getting ACTH still develop the weakness.

Its use, in otitis media, catarrhal, often with slight secondary infection, has been very similar to our results obtained in the sinuses and need not be considered separately. We merely mention that it has been tried, and the results show great parallelism.

The results in asthma are being so well popularized by the internists and allergists, that again I do not feel that there is too much reason to stress this.

CONCLUSION.

1. Inflammation, allergy, anaphylaxis, shock and some hormonal difficulties are the unequal response to connective tissue damage.

2. By treating the inflammatory component of infection, allergy and hormonal difficulties as well as the foci problem itself, we have a new valuable adjunct in ear, nose and throat therapy.

BIBLIOGRAPHY.

1. KALLOS, P.: "Progress in Allergy," Vol. 14, 1955.

2. EYRING, H., and DOUGHERTY, T. F.: Molecular Mechanisms in Inflammation and Stress. *Amer. Sci.*, 43:457, 1955.

3. ROSE, B.: Allergic Inflammation. *Revu Canadienne de Biologie*, 12:335, 1953.

4. DOUGHERTY, T. F.: Effect of Cessation of Treatment with Large Doses of Antiphlogistine Adrenocorticol Hormones on Circulatory Antibodies and Parenchymatory Allergic Lesions. *Revu Canadienne de Biologie*, 12:305, 1953.

5. Dougherty, T. F., and Frank, J. A.: The Qualitative and Quantitative Responses of Blood Lymphocytes to Stress Stimuli. *Jour. Lab. and Clin. Med.*, 42:530, 1953.

6. Dougherty, T. F., and Schneebeli, G. L.: The Use of Steroids as Anti-inflammatory Agents. *Ann. N. Y. Acad. Sci.*, 61:328, 1955.

7. Selye, H., and Heuser, G.: "Ann. Reviews on Stress," 1955-56.

8. Carter, P. B., and Higginbotham, R. D.: The Local Response of Tissue Mast Cells to Antigen in Sensitized Mice. *Bact. Proc.*, 1956.

9. Higginbotham, R. D., and Dougherty, T. F.: Mechanisms of Protection Effect of Hydrocortisone in Staphylococci Infected Adrenalectomized Mice. *Proc. Soc. Exp. Biol. and Med.*, 90:253, 1955.

10. Higginbotham, R. D., and Dougherty, T. F.: Mechanism of Heparin Protection Against a Histamine Releaser (48/80). *Proc. Soc. Exp. Biol. and Med.*, 92:493, 1956.

11. Higginbotham, R. D.; Dougherty, T. F., and Jee, W. S. S.: Fate of Shed Mast Cell Granules. *Proc. Soc. Exp. Biol. and Med.*, 92:256, 1956.

12. Higginbotham, R. D., and Dougherty, T. F.: Heparin, a Biologic Ion Exchange in Protection vs. Noxious Agents. *Fed. Proc.*, Vol. 16, in press, 1957.

UNIVERSITY OF ILLINOIS.

The next course in Laryngology and Bronchoesophagology to be given by the University of Illinois College of Medicine is scheduled for November 4-16, 1957, under the direction of Dr. Paul H. Holinger.

Interested registrants will please write directly to the Department of Otolaryngology, University of Illinois College of Medicine, 1853 West Polk Street, Chicago 12, Illinois.

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Secretary of Otolaryngology Section: Dr. Robert W. Godwin.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd., Los Angeles, Calif.
Time: 6:30 P. M. last Monday of each month from September to June, inclusive—Otolaryngology Section. 6:30, first Thursday of each month from September to June, inclusive—Ophthalmology Section.

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Meeting:

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Meeting: Sixth International Congress of Bronchoesophagology, Philadelphia.

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